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ABSTRACT

At the present time, Florida ranks fourth among the states in volume of high-technology industry, which includes information processing and computer-oriented activity. For this reason, a statewide review of computer science programs underway at the nine campuses of the State University System (SUS) of Florida was recently conducted. This report summarizes the findings of this review. It is the result of interviews with students, alumni, employing officials, community college personnel, and faculty and administrators concerned with the various SUS computer science programs. Twelve generic issues concerning SUS computer science programs were formulated in the study. These statewide issues were: (1) a computer science review conducted in 1978-79; (2) new programs and accreditation of programs; (3) the supply and demand of students; (4) the supply and demand of faculty; (5) equipment; (6) professional activity, and currentness of curriculum; (7) relationships with industry; (8) teacher and continuing education; (9) computing across the curriculum; (10) articulation/program direction; (11) branch campuses; and (12) funding. Included are institutional reports from each of the nine SUS campuses. (TW)

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State University System of Florida

COMPUTER DEGREE

PROGRAM REVIEW

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
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SE 048 673

REVIEW OF
STATE UNIVERSITY SYSTEM
COMPUTER DEGREE PROGRAMS

CONSULTANTS' REPORT AND RECOMMENDATIONS

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and

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Accepted by the Board of Regents May 15, 1987

State University System of Florida
Tallahassee, Florida

BOR 87-1

ACKNOWLEDGEMENTS

In the Fall 1987, the team of consultants who have authored this report conducted site visits to the nine SUS campuses. There, they interviewed current students, alumni, employing officials, community college personnel, and faculty and administrators concerning the various computer degree programs being offered. The departments offering the programs had previously prepared and submitted extensive self-study documents; the visits followed analysis of these documents and other data on the SUS. This report is the result of the efforts and dedication of many people.

The previous statewide program review of computer science programs was conducted in 1978/79. This report makes reference to that review, and indicates progress made since that time.

Dr. William H. Caldwell served a dual role as staff consultant and faculty consultant. We thank him for his energetic, enthusiastic, and thoughtful service and for his excellent performance throughout the study and preparation of this report.

A special thanks to the campus coordinators, who prepared the self-study documents and scheduled meeting rooms and personnel, for their active participation in the review.

Finally, we express our appreciation to the entire staff of the Academic Programs Office for their superb assistance throughout this review. Their careful attention to production methods, schedules and deadlines, and their high quality workmanship have been a significant factor in the success of this review.

C. V. Ramamoorthy
Roland D. Spaniol
August, 1987

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GENERAL REPORT

ON

COMPUTER DEGREE PROGRAMS IN THE STATE UNIVERSITY SYSTEM OF FLORIDA

I. NATURE OF COMPUTER SCIENCE-RELATED PROGRAMS IN THE SUS

At the present time, Florida ranks fourth among the states in volume of high-technology industry, which includes information processing and computer-oriented activity. Although Florida has not yet emerged as a major manufacturer of high-technology equipment, high-technology companies still comprise the predominate industry in the State. Among this industry, the number of companies involved in the computer science area that includes software engineering and software support is growing at a rate of 27% per year; software activities presently are reported to contribute a billion dollars annually to the economy of Florida. This software industry has the potential of attracting high-technology manufacturing because of the opportunity for hardware applications it provides.

To support the growth and development of this invaluable industry, the State has committed itself to the development and maintenance of strong K-12 and higher education programs. Florida has encouraged high-technology development on a state-wide basis and has taken steps to strengthen the university link to high-technology companies.

In this report on computer science, computer engineering, and computer information systems programs in the State University System, we

evaluate the programs involved and provide recommendations for directions that can be taken during the next five years to help meet the high-technology needs of the State.

The State University System offers computer programs at each of its nine universities. Table I indicates the various degree programs currently authorized throughout the System.

AUTHORIZED COMPUTER DEGREE PROGRAMS
IN THE STATE UNIVERSITY SYSTEM 1986

	Computer Science	Computer Engineering	Information Systems	Computer Technology	Department Location
UF	B M	B M D	B M		Arts & Sci Engineering Business
FSU	B M D				Arts & Sci
FAMU				B	Engineering, Agriculture, & Technologies
USF	B* M* D*	B M D		B	Engineering
FAU	B* M*	M D	B M		(Moving to Consolidate)
UWF	B* M*		B* M*		Business
UCF	B M D	B M D		B	Arts & Sciences, Engineering
FIU	B* M* D*				Mathematical Sciences
UNF	B* M*		B* M*	B**	Separate Division

LEGEND B = Bachelor's
M = Master's
D = Doctorate
* = Track in Differently-Named Program
** = UNF No Longer Offers This Degree

TABLE I

Through this collection of programs, students throughout the state have ample access to the various forms of computer degree programs that have evolved over the years.

Nationally, Computer and Information Science curricula generally are categorized as:

a) computer science programs;

b) computer engineering programs;

c) information systems programs; and

d) data processing and computer technology programs.

Although the definitions of these categories are not exact, broad definitions are agreed upon.

Data processing and computer technology programs are usually lower-division, vocationally-oriented programs. The computer technology programs in the State University System of Florida emphasize hands-on experience and training in fundamental applications and operation of computer systems. These computer technology programs also, in part, emphasize elementary hardware design and technology. Such programs are not intensive in theory or science, as are the universities' computer science, computer engineering, and computer information systems programs. These latter programs are academically stronger and are intended to provide the educational foundation for highly trained professionals and for students who have the ability and knowledge to enter graduate schools in the nation.

Information systems programs usually emphasize applications of computer science technology in the context of organizations and society, and business-oriented applications. Such programs are often housed in business schools.

In various universities throughout the country, computer science and computer engineering programs are found in colleges of arts and sciences, colleges of engineering, or in stand-alone units. The consultants' report on the 1978/79 Board of Regents Computer Science program review provides a good description of computer science and computer engineering programs; these are included in the appendix to this report.

In the previous report, a plan for developing Computer Science in Florida was proposed. Later in this report, the recommendations of that plan are reviewed in the light of developments over the past eight years.

In some of the SUS undergraduate curricula, the existence of several overlapping but differently-named programs, housed in different colleges, has created confusion about the nature of the computer degrees granted by Florida institutions. Preferably, the State University System should use the nationally recognized generic names for degrees, such as B.S. in Computer Science, B.S. in Electrical Engineering and Computer Science, B.S. in Computer Engineering, or B.S. in Computer Information (Science or) Systems. This not only will help the students in seeking employment (because the nature of their degrees would be more easily understood, nationally), but also will help students seeking admission to out-of-state graduate programs.

It is wise to separate administratively a computer science-oriented program from a computer information systems-oriented program. Indeed, such programs should be offered by distinct departments, whenever possible.

There is also a degree identity problem at the master's level. Some universities offer their computer master's program as a part of a program leading to a mathematics degree, and in one university the program leads to a degree with a unique name--Systems Analysis. We recommend that master's degrees be designated with nationally-recognizeable names, as well.

> **Comment and Recommendation:** Each institution should consider a planned reorganization which will result in the designation of recognized degree structures at all levels, and suitable administrative location for their effective delivery.

This "degree identification" concern was the only issue identified during the review which was not encompassed readily by the generic issues which comprised the planned focus of this review. In the following section, the analysis of these latter issues provides an overview of the status of computer programs within the System.

II. STATEWIDE ISSUES

To provide direction for the review, the staff worked with the universities to develop a list of twelve generic issues that were to be examined on a Systemwide basis. These issues are outlined below.

ISSUE ONE. The 1978-1979 Computer Science Review.

A. Baccalaureate Programs

a. Computer Technology Programs

It was recommended in 1978-79 that Florida A&M University (FAMU) move towards strengthening its bachelor's degree in data processing technology, and eventually replace it with a B.S. in Information Systems to be developed in cooperation with the School of Business. This step has not yet been taken; however, FAMU has taken steps to strengthen its B.T. program, and is presently seeking to eliminate that degree title. Currently, the program is administratively located as a Division in the College of Engineering Science, Technology and Agriculture. The Division faculty are discussing the development of a curriculum more compatible with its present location, or the relocation of the Division to a unit where an information systems program would be appropriate. The B.S. program recommended by the previous consultants is not the most suitable for the Engineering Science College, so the future direction of the FAMU program is uncertain.

The University of North Florida (UNF) partially followed the recommendations set forth by the previous report; that is, even though they initially continued to offer a computer science curriculum under the auspices of the Mathematical Sciences Department, they did institute a Bachelor of Technologies program in Information Systems Technology.

Both of those programs since have been subsumed by the recently-created Division of Computer and Information Sciences; and UNF no longer offers the computer technology degree.

Since 1978, several SUS schools have implemented computer technology programs in addition to their computer science and/or computer engineering programs. These technology programs do not have the kind of depth that prepares one for a wide range of employment or gives great potential for advancement. They are usually in tune with existing technology; however, the technology is changing so rapidly that graduates of such programs soon fall behind their peers who have completed more substantial, traditional computer degree programs.

> Comment and Recommendation: The 1978 recommendations concerning computer technology programs advised that such data-processing-oriented training provides restricted professional opportunities, and that coordinators of such programs should concentrate the first two years on preparation for a more rigorous four-year program. During the period 1985-1995, the two-year student is likely to experience a continuing restriction in employment opportunity, and the four-year technology student will probably experience the same. Since the technology curricula do not allow for easy transition by students into the more rigorous computer curricula, technology programs will probably experience a decline in student demand. Since the State University System is experiencing a heavy demand on its resources, it should consider phasing out computer technology programs and redirecting those efforts to three types of computer degree programs: Computer Science, Computer Engineering, and Computer Information Systems.

b. Information Systems Programs

In the previous review, Florida Atlantic University (FAU), Florida International University (FIU), the University of West Florida (UWF) and the University of Florida (UF) were encouraged to offer Bachelor's Degrees in Computer Information Systems, housed in their Schools or Colleges of Business.

The Florida Atlantic University program has been located in the Business College as a part of the Department of Computer and Information Systems. The Computer Science component of that program soon will become a part of a new administrative unit reporting to the Academic Vice President. (Recommendations on this reorganization are included in the FAU institutional report, later in this document.) The Computer Information Systems component will continue to be developed and strengthened in the College of Business.

Florida International University has maintained its Computer Science program within the Department of Mathematical Sciences and has not taken steps to develop a computer information systems program. UWF's Systems Science program has an information systems component as well as a scientifically-oriented component. It is located in the College of Business--however, with these somewhat disparate tracks, it is questionable as to whether it should remain there. The University of Florida continues its unique administrative arrangement of being a cross-college department housed in Engineering yet offering programs in Engineering, Business, and Arts and

Sciences. The UF Computer Information Systems track must have its curriculum approved by the College of Business.

FSU has a Management Information Systems Program (B,D) in its College of Business; however, these programs are more business and management oriented than computer information systems programs envisioned by the consultants.

> Comment and Recommendation: The institutional responses to the 1978-79 review recommendations have been influenced by regional responsibilities as well as resource constraints. Failure to have developed computer information systems degree program tracks at some universities, and housing some programs outside of Business Colleges is a reflection of the individuality of the SUS institutions, and does not of itself detract from the quality of programs or service to the State. However, institutions should monitor the needs of their constituencies on a regular basis, to see that the information systems curricula being provided are suitable to and adequate for that need. This is discussed further in the individual institutional reports.

c. Computer Science Programs

Florida International University (FIU), Florida State University (FSU), the University of Central Florida (UCF) and the University of Florida (UF) were recommended to provide the SUS programs in computer science. These were expected to have originated in mathematics departments in Colleges of Arts and Sciences, and eventually grow to become separate departments in their respective colleges. The FIU Computer Science degree program began in mathematical sciences and has remained there; the UCF program began in mathematics and is now a separate department in the College of Arts and Sciences; the FSU program

followed the UCF route; and the UF program is in the College of Engineering, with the Arts and Sciences College reviewing the computer science curriculum track. Thus, for the most part, this 1978-79 recommendation has been accepted.

In addition to those schools recommended to offer computer science, UNF has continued to offer a computer science track, now through the Division of Computer and Information Sciences. FAU also developed a computer science track in the mathematics department--that track presumably will be offered by the new FAU unit providing computer-related degree programs, and may end up outside of the College of Science. The University of South Florida (USF) offers a computer science track in its College of Engineering-based program. FSU has a computer concentration in its electrical engineering baccalaureate program, and a hardware concentration in its physics program.

> Comment and Recommendation: The various SUS computer science programs have curricula based on sound national curricular guidelines. They have developed to meet a need, and are serving their students and their regions well. They should continue to be offered, and should be administratively situated in locations which foster continued quality along with the professional development of the faculty and of faculty in related disciplines.

d. Computer Engineering Programs

UCF, UF, and USF were recommended to be the SUS universities to provide computer engineering programs, and accreditation was recommended for such programs. Both the UF and USF

programs are accredited, as is the relatively new computer engineering program at UCF. In addition, FAU and FIU are looking at the possibility of offering computer engineering bachelor's degree programs in the future.

> Comment and Recommendation: Computer Engineering is a part of Electrical Engineering programs in universities like Purdue, the University of California (Berkeley), the University of Illinois, the University of Texas, MIT, and Stanford. Some of these universities also provide a combined Department of Computer Science and Electrical Engineering, due to the strong interrelationships of those disciplines. In places where Computer Engineering exists as a separate academic unit, often it will draw upon the academic resources and facilities of a Computer Science Department located elsewhere within the university. Interactions among faculty in computer engineering, electrical engineering, and computer science are highly desirable, and should be fostered.
>
> At UCF, UF, and USF, the computer engineering programs are separate from electrical engineering, and UCF's program is in a distinct department from computer science, as well. At FAU, the relationship of any new baccalaureate computer engineering program to the new computer degree-offering unit is yet to be determined.
>
> In any event, all SUS institutions must be sensitive to the natural symbioses among computer science, computer engineering, and electrical engineering, and need to design the administration of such programs to foster the interaction of these faculties, facilities, and curricula.

B. Master's Programs

The previous review indicated that only universities with strong bachelor's programs should develop master's programs, and that the direction of the master's curricula should correspond to that of the baccalaureate. All institutions except FAMU, FIU and

UNF were projected to develop master's programs; and all of those have done so, in the areas the consultants recommended. FIU also developed a master's option in computer science, and UNF has offered a track in computer science as a part of its Master's in Mathematical Sciences. UNF has requested authorization to implement a stand-alone Master's in Computer and Information Sciences in the Spring of 1987; FAMU does not have plans for a master's degree program at this time.

Master's degree programs serve two distinct functions. For professionals in industry they often represent the terminal degree, and as such must have a definite applications orientation. For those students looking forward to Ph.D. study, the master's program must incorporate much more extensive theory. In planning and delivering master's programs, both of these needs must be incorporated; this usually requires separate tracks to be accomplished effectively.

> Comment and Recommendation: The building of master's degree programs upon strong, well-organized baccalaureate programs is wise. Existing faculty provide the fundamental support, and additional personnel costs can be low. Further, the incremental equipment needs, although not inexpensive, are also not prohibitive. (This, of course, assumes that the existing baccalaureate program is properly equipped and funded.) Many of the Florida programs have been developed to satisfy regional needs, and appear to be performing that role quite satisfactorily, on a statewide basis. However, some programs do not appear to provide the balance of offerings that allow all students to select both theory and applications which are appropriate to their particular degree objectives. Each university should examine its master's curriculum to see that such opportunities are made available to its students.

Planning for master's programs beyond those existing or currently proposed is not on the horizon, and should not be, prior to the next review.

C. Doctoral Programs

The previous consultants recommended that up to eight Ph.D. programs in the computer disciplines might be developed statewide.

FAU was suggested as a possible candidate to offer an information systems-oriented Ph.D. program; however, it has not moved in that direction. The computer information systems doctoral option is not available through existing programs in the SUS.

UCF, UF, and FSU were considered suitable for computer science Ph.D. programs; and all offer that degree, as does FIU. Degree productivity of all of these programs is still quite low, due to their recent creation.

UF, UCF, and USF were proposed as good sites for computer engineering programs. All three have developed such curricula, as has FAU. Again, there is no history of productivity to report.

Comment and Recommendation: The controlled development of Ph.D. programs over the past five years has been well-considered. A strong Ph.D. program requires an entirely different faculty direction than do baccalaureate and master's programs. Further, the expense for graduate research equipment at the doctoral level is an order of magnitude greater than the lower degrees require. It is notable that, for the most part, the SUS has followed the 1978-79 recommendations concerning Ph.D. programs in a measured, careful manner. The System might consider the addition of a Ph.D. track or program in Computer Information Systems, as resources permit.

D. Summary

The recommendations of the 1978-79 review team have been examined carefully by the universities and the SUS; the growth of computer science programs throughout the state has followed a pattern developed using the previous review's conclusions as guides, tempered by each university's analysis of its region's changing needs. The evolution of the programs over the next five years can use the present review's analysis of issues for direction in a similar fashion. The departments and programs are maturing and have reached the point where their missions are clear; their strengths and weaknesses relative to those missions are better understood, and the universities can direct their energies toward improvement of those weaknesses and enhancement of the strengths.

ISSUE TWO. New Programs and Accreditation of Programs.

New degree programs are being considered at several institutions in the System. FAMU is considering revising its technology program to a B.S. program, UNF has proposed the implementation of a new master's degree program in computer and information systems,* and FAU is discussing the possibility of developing a B.S. in Computer Engineering. The consultants are comfortable with all of these, as delineated more carefully in the individual institutional analyses within this review report. Beyond these additions and changes, the consultants see no need for new programmatic activity at the bachelor's or master's level for the next five years.

*The Board of Regents granted approval in January 1987.

Some universities are thinking about developing Ph.D. degree programs in Computer Science, Computer Information Systems, or Computer Engineering. However, only UF, UCF, FSU, and USF currently meet the criteria for offering such programs. The major criteria are:

(a) sufficient graduate research faculty to supervise research;

(b) a critical mass of faculty interested in this specific research area;

(c) a critical mass of students of high academic quality;

(d) relatively low teaching loads to provide critical research time for faculty; and

(e) ample research equipment and computing resources.

Each of the remaining universities in the System fails to meet at least three of these criteria (even though FIU is presently authorized to offer a Ph.D. program), and will require significant increases in strength and support before being in a position to initiate a quality program. An institution's national reputation is based upon the quality of the Ph.D. students it graduates. By initiating a doctoral program before fulfilling the above criteria, the university jeopardizes its reputation for some time into the future.

> Comment and Recommendation: Institutions will develop plans for their own growth and expansion; in some cases, this does not take into account the needs of the State or of the nation. The Board of Regents must consider those needs, and must place quality in a higher priority than quantity. The System should concentrate on the development and strengthening of existing Ph.D. programs, and should consider initiating new doctoral programs only when in a position to see that those can be started with sufficient faculty,

student and equipment resources to be of high quality from the outset. No new baccalaureate or master's programs are needed, beyond those presently under consideration.

There are presently two basic kinds of accreditation for computer baccalaureate degree programs. The Accreditation Board of Engineering Technologies (ABET) accredits computer engineering programs along with other engineering disciplines, and the Computing Sciences Accreditation Board (CSAB) recently has established accreditation standards for computer science programs. There are no accreditation standards available as yet for information systems programs, and graduate computer programs are not accredited by any agency.

Accreditation is a means of maintaining program quality and of assuring graduates of recognition of their training by agencies, firms, and institutions beyond the local market. Through accreditation, a faculty is able to measure itself and its curriculum against departments nationally, and to determine better those areas in which improvement can be achieved. Accreditation standards provide a faculty with a benchmark against which to assess themselves, their curriculum, their resources, and their students. Thus, achieving accreditation enhances a department's internal as well as external image.

FSU and UNF are among the first schools nationwide to seek CSAB accreditation, and several others in the SUS are considering the pursuit of accreditation in the future. Although this accreditation process is new, it is the opinion of the consultants that it should be encouraged throughout the SUS, as ABET accreditation should be sought

for engineering programs. When standards are developed for computer information systems programs (both the Association for Computing Machinery and the Data Processing Management Association are considering the development of such standards), that sort of accreditation should be sought by appropriate SUS programs.

> Comment and Recommendation: The Board of Regents should encourage the accreditation of computer degree programs in the SUS, through CSAB or ABET as appropriate.

ISSUE THREE. Supply and Demand: Students.

Since the last review, several new computer degree programs have been started, and interest in computer education has sky-rocketed. All departments have high student enrollment, particularly at the undergraduate level, where enrollment has increased by several magnitudes. (The graduate programs, on the other hand, have not grown as rapidly.) Although enrollment in computer degree programs is declining nationwide, it appears to be stable or increasing at the Florida institutions.

In the intensive industrial areas, such as Southeast Florida, Orlando, Tampa, etc., there are many part-time students, at all levels. This makes program delivery difficult, and severely hampers research degree programs. The position taken in the previous review must be emphasized: graduate programs, particularly Ph.D. programs, cannot be founded on part-time students. Special steps must be taken to increase the population of full-time students--expanded recruitment efforts (including seeking outstanding foreign students who might be interested in locating permanently in Florida upon completion of their programs)

and increased financial support and fee waivers, for example. Such measures not only can increase the numbers of full-time students, increased support also will speed up the completion times of some part-time students. If a university does not elect to fund graduate stipends well, it may not achieve the planned doctoral level enrollments in this discipline.

In almost all institutions, computer science is a limited access program, requiring relatively high GPA and SAT scores for admission. Nevertheless, enrollments are still very high; and high enrollment means very large classes, large investment in equipment which quickly grows obsolete, and large teaching loads for the faculty.

The quality of education will suffer if such trends persist. It is recommended that the State University System of Florida use average student-faculty teaching load ratios of high quality institutions throughout the country as a guide to establish suitable class sizes, program sizes, and faculty teaching loads.

In several SUS universities, there is faculty uneasiness with respect to the quality of undergraduates, particularly with regard to the mathematics preparation of high school graduates. Increased interaction between the high schools, the community colleges, and the universities must be fostered to improve this.

The graduate student quality also can be improved. Measures such as requiring higher undergraduate grade point ratio and GRE scores for admission, adequate course preparation by the students prior to admission, and most importantly, providing more financial support for the students will be of benefit in this regard.

Except in isolated instances, the review team feels that more incentives should be provided by the universities to attract and keep minority students. Since many native minority students wish to stay in Florida, and since their population mix is underrepresented in the State University System, additional attention and financial support should be made available to provide greater encouragement to attend SUS institutions. Increased, reaffirmed commitment by both academic advisors and faculty towards the recruiting of minority students is encouraged. This can take the form of more direct involvement in the public schools throughout the K-12 spectrum. It is understood that some of this sort of interaction is being carried out through the McKnight Foundation and various outreach programs; however, individual departments need to become involved.

This recruitment is especially important since minorities, particularly blacks, are considerably underrepresented among faculty ranks. Recruiting blacks, women, Hispanics, and other minorities into undergraduate programs, and from these to graduate programs, is the only way this situation will be resolved.

Baccalaureate employment opportunities appear to be very good within the state of Florida, but many of the programs in the State University System do not appear to have emphases or components directed toward the needs of the local region being served. For example, FSU has a strong program in artifical intelligence (AI) and expert systems, but the FSU program does not seem to have a component well-suited to local business and government needs. Similarly, to fulfill the needs of their regions, FAU and FIU should be offering strong software engineering and providing

more strength in the foundation computer science areas than they do at this time. These are but examples. Every university has areas in which it could improve the scope and/or direction of its offerings. Each SUS university must review its department's role on a continuing basis to determine that the computer program options being offered are suitable to the university's mission and respond to changing regional and state needs.

For the student entering a career, as well as the one who wants to continue into graduate school, success is determined by the depth of his or her undergraduate program. Many of the SUS institutions must strengthen the fundamental computer science curriculum and a few must broaden their spectra of applications-oriented coursework in order to give preparation for the kinds of opportunities their graduates should enjoy. Specific recommendations in this regard are included in the individual institutional reports being provided.

Computer science students should be educated for tomorrow's world and markets--in order to prepare students who can deal with the rapidly changing technology, the curriculum must be based upon strong theoretical and scientific foundations; and the theoretical, technological, and applications-oriented aspects must complement one another. In order to see that students take advantage of the opportunities the curriculum provides, strong faculty advisement must be provided consistently throughout the students' programs.

Comment and Recommendation: Overall student demand for computer programs in Florida universities is still strong at the undergraduate level; however, each institution should reaffirm its commitment to recruit and retain highly qualified minority students. Graduate student recruitment efforts need to be increased, and greater incentives (assistantships, fee waivers, etc.) provided for students with outstanding potential. [For example, one might offer three $8,000 rather than four $6,000 assistantship or fellowship awards, and thereby attract more high quality students. Outstanding foreign students can be sought in addition to native Americans.]

Florida should survey selected high quality institutions nationwide to determine their computer program teaching loads--both courses and student enrollments. These data should be used to determine a suggested program size and faculty load for SUS computer degree offering units.

SUS universities should examine their curricula to see that they provide students with opportunities to obtain strong backgrounds both for entering careers and for continued study.

ISSUE FOUR. Supply and Demand: Faculty.

Because Computer and Information Sciences is a young, rapidly changing discipline, there are few yardsticks to measure the quality or the suitability of the faculty. First of all, the demand for qualified faculty is still high, particularly for those who recently have received their doctoral degrees. Although this situation is improving, it remains a "seller's market;" younger and newer universities, like several in the SUS, still have difficulty attracting desired faculty, despite considerations such as the excellent climate and desirable tax structures with which Florida is blessed.

Research quality of the SUS faculty with specific expertise in computer science areas varies, but is improving Systemwide. Strong research capability exists at UF, UCF, and FSU; and USF recently has

concentrated its faculty recruitment on increasing departmental research potential. FAU, UNF, FIU, and UWF have been enhancing their research emphasis over the past few years, as well. Several SUS institutions now have faculties that would compare quite favorably on a nationwide scale.

Several standards for use in future hiring and some strategies for attracting the most appropriate faculty to the various institutions in the state are proposed below.

The following criteria constitute minimal qualifications for new faculty:

1. Possession of a terminal degree in one of the areas of computing, with a strong research emphasis;
2. Indication of strong teaching ability and the inclination to develop into an excellent teacher;
3. Excellent communication abilities; and
4. A good history of, or potential for, research accomplishments, as evidenced by publication records and peer evaluations, in a research area supportive of the departmental research focus and/or the needs of the region.

The fourth criterion above is the one most frequently sacrificed in hiring. The SUS universities consider the possession of a terminal computing degree to be an overriding consideration--general publication areas are not given the emphasis that reflects the existence of a plan for departmental development. However, the programs in the System are sufficiently mature, and the availability of faculty is increasing sufficiently that each SUS computer degree-offering unit can establish an individual broad area of focus, and then recruit faculty to emphasize that focus.

In spite of intense competition for outstanding faculty nationwide, and the fact that most universities desire faculty with the qualities listed above, Florida should insist upon recruiting faculty with such outstanding potential. In some cases, this will mean offering computer program faculty beginning salaries which exceed those of experienced faculty in other disciplines. Although such extreme measures can cause morale problems, without such faculty the quality of computer education and research will not meet the aspirations of the State.

Although quite important, salary is seldom the most important consideration of the new doctoral graduates. Ample research time, which can be translated into lighter teaching loads (e.g., one class per semester) is very important, as are better research facilities; and most important to many new Ph.D.'s is the existence of a strong, well-focused doctoral program with excellent graduate students.

Some leading state universities such as Texas, Illinois, California, Minnesota, and Purdue not only have given higher than average beginning salaries (in the range of forty-two thousand to forty-eight thousand dollars for nine months) but also have guaranteed up to three years of summer salary, and seventy-five thousand dollars of support for graduate students and initial research. Unless Florida follows these (admittedly expensive) policies, it will be difficult to attract the best new faculty.

A complementary means of attracting high quality young faculty is to recruit established leaders in research to serve as Distinguished Chair Professors or Eminent Scholars. Each SUS university should seek one or two research-oriented senior faculty of national reputation whose research interests overlap the regional needs and departmental research

focus. While it may seem to be very difficult to locate and attract such people, many research pioneers at IBM, AT&T, etc., are being asked to consider early retirement. If these experts are still active in current research, they might be interested in assuming research leadership in an academic setting.

Travel money and funding for interviewing faculty candidates appears to be very limited, Systemwide. Perhaps the universities can benefit from emulating schools such as Berkeley, where other universities in the area (Stanford, UCLA, etc.) are notified when a mutually desirable candidate is being interviewed so that several universities can share the candidate's travel costs.

One recommendation that cannot be overemphasized is that each University must develop a recognized focus for departmental research. A critical mass of researchers in that field must be recruited; and these people must be the very best that can be found.

In several universities we encountered faculty members who had moved from other disciplines into computing. Sometimes this works well, and the individuals become productive contributors to their newly-acquired specialty. However, there are also instances when such moves are made merely to improve financial prospects, without an innate or natural inclination to contribute to computer research areas. To appoint such individuals in order to fill classrooms can compromise the interests of the program; it is preferable to curtail programs or reduce course offerings rather than hire such persons. Further, tenure and promotion of any faculty member should depend upon having engaged in a meaningful research component within the discipline.

Comment and Recommendation: Each SUS university should establish a broad research focus, and recruit faculty with expertise supportive of that focus. In hiring faculty, the criteria outlined in this section should be used, and universities should be prepared to provide the level of salary and support incentives required to attract high quality faculty. Each university should strive to acquire one or two established leaders in its program's area of focus, and use them to attract outstanding younger faculty.

ISSUE FIVE. Equipment.

The computing and research equipment used in the SUS computer programs varies from school to school. General purpose computing equipment for teaching in undergraduate programs seems to be much improved from the time of the previous review; indeed, these general purpose facilities now are quite adequate for the computer programs on most campuses. At some universities, though, there remain crowded conditions and insufficient space for students to work with computers. Such inadequacies must be corrected as quickly as possible. Space issues are addressed in the individual institutional reports.

Computer hardware courses and their associated laboratory areas appear to be ignored in those programs which are not situated in engineering colleges. This is unfortunate. Both the ACM and the IEEE postulate "hands-on" hardware design labs and "hands-on experience in hardware design and its implementation" as essential curriculum components. Each SUS institution should strive to see that this critical ingredient in a basic computer science program is given adequate coverage and support in the curriculum.

The general-purpose computing equipment for instructional purposes must be kept up-to-date and be accessible, both campus-wide and outside

of the campus via dial-up facilities. Since computer science education advances rapidly, it is a good rule of thumb to replace computing equipment every five years.

One way of evaluating the adequacy and currency of equipment is through accreditation. Accreditation in the areas of computer science and engineering requires that equipment be up-to-date, reasonably accessible to the students, and available during off-hours, including weekends.

For graduate education, a university's equipment must be tailored to the targeted research specialization of the institution. Seed money for research equipment must be provided so that the younger faculty can initiate and sustain their research without waiting for external sources. Agencies such as the National Science Foundation generally provide support only to institutions that are able to exhibit adequate basic research facilities in the area of proposed research. Since much research is supported either by the federal government or by industry, and funding for initial research equipment is rarely granted by them, the State must invest in basic research equipment purchases. The nature of such equipment will depend upon the institution's established research focus; however, the closer an institution aspires to be to the leading edge of the discipline, the more expensive it will be to acquire and maintain requisite equipment.

Many campuses have a heterogeneous assortment of aging computing equipment that has been donated to the institutions. Since donors of such equipment usually do not support its maintenance, cost of maintenance has fallen upon the department or college. This high cost of

maintenance creates a burden on a departmental budget; accepting such equipment must be done very carefully, and with maintenance costs in mind. Perhaps in some cases, the inclusion of such costs could be a contingency of accepting a gift.

It is important that terminals and associated equipment, e.g., printers, copiers, etc., be located near one another, for ease of use by the students, staff, and faculty. This equipment must be available for long hours, and also by remote access via telephone. Because of high part-time student enrollment at many SUS institutions, this remote access is vital.

To augment the sharing of equipment and specialized software packages, a catalog of sharable hardware and software facilities within each institution should be developed and made accessible to local users through Local Area Networks (LAN's). These catalogs could then be made available statewide through the Florida Information Resources Network (FIRN). Such arrangements will involve the cooperation and the support of computer center directors, department chairpersons, and research units.

> Comment and Recommendation: Computer equipment for general purpose undergraduate instruction seems to be satisfactory at each SUS institution; great progress has been made in this regard since the previous review. However, many institutions need laboratory equipment associated with computer hardware courses. Steps must be taken to provide proper support for this essential curriculum component.
>
> Seed money for equipment in support of the research efforts of junior faculty should be supplied routinely. Each university should consider the cost associated with equipment and maintenance both when determining departmental research focus and also when accepting donated equipment.

Each institution should develop an internal catalog of sharable hardware and software; these catalogs should be available internally through LAN's and throughout the SUS through FIRN.

ISSUE SIX. Professional Activity and Currentness of Curriculum.

Professional development includes faculty participation in conferences, tutorials, seminars, and workshops, as well as involvement in professional society activities, and individual scholarly study. The faculty development area seems somewhat neglected at most schools. There is much faculty concern about the scarcity of travel money and the absence of a policy that encourages attending important research and curriculum-oriented conferences. There also seems to be little institutional support for colloquia, seminars, etc. Perhaps funding can be sought from industry as well as the State for these purposes. Industrial funding for such faculty activity is a largely unexplored area; if properly cultivated, it could enhance both the university and the industry involved.

Each curriculum delivered by a department must be evaluated on a periodic basis for its scope, content, and currentness; for undergraduate programs, this can be accomplished eventually through accreditation reviews. Presently, many of the undergraduate programs need a better balance of theory and practice; for example, the USF curriculum can benefit from more theoretical courses, FSU from increasing the practical orientation (in both its curriculum and research), and FAU from adding strength in core computer science. Each institution should look at its curriculum with balance in mind. Although a curriculum to some degree reflects the faculty's principal research interests, minimum balance and

breadth must be maintained in the undergraduate programs. The core courses recommended by the ACM and IEEE Computer Society's Undergraduate Curricula are excellent models for this purpose. A good guideline could be to have at least one quarter of the offerings beyond the basic and core requirements being applications-oriented, and at least another quarter theoretical or technological in nature.

It is recommended strongly that the SUS computer department chairpersons meet regularly, perhaps annually, with the purpose of reviewing and comparing each other's curricular aspirations, faculty research interests and other related matters. Also, each department should initiate regular internal reviews of curriculum and research, rather than waiting for a scheduled BOR review.

Finally, each institution should establish a joint student, faculty, and industry advisory committee to look into the programs and concerns of the department, and to provide feedback to the department and the administration. Ideally, such advising groups will include experts from non-local industry and academic institutions, to provide a broader framework for comparison.

> Comment and Recommendation: Each institution should extend its efforts to provide professional development incentives and opportunities for its computer program faculty. Both regional and national industries should be approached to explore their support of activities such as seminars and colloquia, which form an important component of professional development. A joint student/faculty/industry advisory group should be formed by each institution to help guide curricular and programmatic development. These groups, coupled with periodic meetings of the program chairpersons and directors from throughout the system, could supply the foundation for well-organized curriculum development and maintenance statewide.

ISSUE SEVEN. Relationships With Industry.

A great deal of interaction between industry and the universities exists statewide, particularly between universities and nearby industries. If this interaction were expanded to include a greater number of national industries, it would provide a greater visibility to Florida's computer science higher education.

Several industries have made excellent equipment donations to state university components. Our caveat about maintenance notwithstanding, a university cannot stay at the forefront of evolving computing technology without extensive, timely equipment support from industry.

Among the manifestations of industrial support have been the direct support of part-time student employment, and cooperative programs. It is recommended that the universities seek additional industry funding for scholarships and fellowships which would support more full-time students.

Some industry support comes in the form of contracts for developmental projects, which can be construed as seeking inexpensive student labor. Faculty members must be selective in their choice of contracts. Accepted contracts must have a high percentage of research orientation and be consistent with the universities' missions.

Industry also has supplied expertise in support of the various university computer programs. Indeed, industry has been generous in allowing employees time to pursue adjunct teaching positions. Such adjuncts contribute greatly to the major offerings by providing the insights of the professional practitioner. However, it is important to have core undergraduate courses taught by faculty who recognize the role and placement of those courses in the curriculum. Adjunct instruc-

tors usually are used for specialized offerings in which they are experts, as opposed to presenting basic courses within the curriculum. A faculty committee must screen adjuncts carefully in fulfilling curricular needs.

Industrial cooperation has been enormous; however, these relationships still can be enhanced. For example, the universities could join with industry to organize and present statewide research computer conferences and symposia. The partnership can be strengthened further if mechanisms are developed to ensure that undergraduate advising includes a program fostering awareness of the State's high-technology needs and prospects.

> **Comment and Recommendation:** Most universities have established strong relationships with nearby industry. These relationships should be enhanced through the creation of advisory groups suggested in Issue Six, and should be expanded to include cooperative efforts such as statewide conferences and symposia. Selective use of industry personnel for the delivery of specialized coursework also enhances university/industry linkages, and can be very beneficial to students' programs.

ISSUE EIGHT. Teacher and Continuing Education.

Engineering continuing education in Florida is done primarily through the Florida Engineering Education Delivery System (FEEDS); however, there is no comparable set of offerings emphasizing computer degree programs. Computing professionals have a great need for continuing education courses because of the very fast growth of the technology; therefore, each university should develop a mechanism for monitoring the needs of the computer professionals employed in its region, and design

offerings to satisfy those needs. Perhaps the joint university/industry advising committees recommended in Issue Six can constitute such a mechanism.

Frequent short courses, seminars, etc., should be offered by the SUS universities to provide professionals an opportunity to avoid obsolescence in their areas of expertise. Course credits for continuing education courses applicable toward a Master's degree can be explored, to make such offerings even more desirable. For some time, Florida universities have provided ample opportunities for continuing education directed toward general computer literacy or toward training in specialized office uses of computers; now the SUS institutions should address more completely the needs of the state's computer professionals.

> Comment and Recommendation: Each SUS university should develop and provide comprehensive continuing education opportunities for local computer professionals. Such offerings should be planned in consultation with the recommended industry/university advisory board to assure that they encompass both the educational and professional goals of the prospective participants.

Teacher certification in computer science is imminent in Florida, and requires the attention of the SUS. Although pre-service teaching programs will incorporate certification requirements automatically, there are a large number of teachers presently in the field who will seek certification through in-service opportunities. It is not reasonable to expect all of those to complete the requirements through taking standard courses over a protracted number of summers. Special mechanisms for delivery must be developed; and university computer program departments

must bear the primary responsibility for their design. With certification standards anticipated for completion within the year, action must begin immediately.

> Comment and Recommendation: To provide in-service certification opportunities for secondary school computer science teachers, and thereby professional rewards for their achievement, each university computer program department should begin immediately to work with local school districts and the College or School of Education to develop special training programs that will lead to certification for in-service public school teachers of computer science.

ISSUE NINE. Computing Across the Curriculum.

The consultants found no faculty concern about dispersion of computing educational activities across campuses at eight of the institutions. At FAU, an imminent reorganization is designed to centralize the administration of computer degree programs, and consequently will eliminate concerns about dispersion at that university, as well.

Each of the nine universities has its own administrative organization and location for its programs. The delivery systems imparted through these arrangements appear to be effective, for the most part. In the cases where a university might benefit from examining its present organization, specific recommendations are made in the individual institutional reports. Thus, the consultants did not find "Computing across the Curriculum" to be an issue requiring any Systemwide recommendations.

ISSUE TEN. Articulation/Program Direction.

As the market for individuals with the Associate of Science level of training in computing skills diminishes, the community colleges are seeking a closer linkage for their two-year programs with the university programs, and are trying to gain approval for offering computer courses which will transfer into the corresponding upper division curriculum. This requires careful planning and close cooperation to assure that the content and requirements imposed in the community college version of a course are consistent with those of the university's.

Such cooperation becomes even more important as the curriculum evolves and a larger number of computer courses are placed naturally into the lower division. Such courses should be offered at community colleges, and the community college transfer should have the opportunity to start on equal footing at the upper division level with the native university junior.

This process is being implemented at three or four universities, and being thought of or planned at others; however, it still raises a great deal of apprehension on the part of the universities. Universities are comfortable with having community colleges offer computer literacy and special training courses (such as word processing), but are not yet confident that introductory major courses will be presented rigorously there.

> Comment and Recommendation: Introductory major courses in most disciplines are delivered successfully at community colleges in Florida. In mathematics, for example, community college students usually complete the majority of their calculus coursework before transfer; data indicate that

transfer students fare as well in the upper division as native students do. Computer Science students also should have the opportunity to begin their introductory major work before the junior year. Each SUS university computer unit should establish agreements whereby their primary feeder community colleges would be encouraged to offer introductory major coursework in computer science. Such courses will parallel the university's offerings and automatically will satisfy the corresponding curriculum requirement for the student who transfers from the community college into the university's program. Through recognizing and supporting the natural filtration of basic computing courses into the lower division (even into secondary schools), the SUS universities will be able to enhance their own curricula while simultaneously enhancing those of the community colleges and public schools.

ISSUE ELEVEN. Branch Campuses.

Several universities have branch campuses on which computer programs are being offered. For some of these, e.g. FAU and USF, the offerings seem to represent a burden on the department since they are delivered by main-campus faculty who commute to the remote site. At other campuses, e.g., UCF, the branch is served by resident faculty and adjuncts, so that there is not the apparent drain on main campus resources.

Nevertheless, there are distinct problems inherent in branch campus operation, particularly in a discipline such as computing. First, the availability of top-notch faculty is such that it is extremely difficult to attract a high quality person who would be assigned to work remotely from the university's primary faculty and resources. Furthermore, there are certain courses, particularly those with extensive laboratory content, that are not suitable for branch campus delivery unless that branch has a fully-equipped laboratory.

Although time did not permit thorough examination of the effect of branch campus operations, several universities expressed concern that offering computer courses at branches merely relocated on-campus enrollments rather than generating new student opportunities.

> **Comment and Recommendation:** Although it is important to provide opportunity to computer education throughout the state, such provision should not be permitted to detract from main campus program operation. Thus, branch campus offerings generally should be confined to general education courses in the various disciplines. A full program should be offered only when the university is able to obtain a core of full-time faculty in the discipline, locate those faculty permanently at the branch, and supply adequate equipment support to assure that the branch offering maintains the quality achieved by the main campus operation.

ISSUE TWELVE. Funding.

Although there are many funding issues--faculty salaries, research support dollars, large equipment requirements, etc.--the one presented in this review was that of covering the cost of providing computer resources for general student use.

Two generic models exist: recovering costs via a charging algorithm (charge-back model), and open access with off-the-top-funding to support computer services (library model).

Several universities already use the library model, and incorporate security measures and careful monitoring to discourage abuse. Others operate successfully under charge-back models. All of the universities we talked with agreed that the library model could be effected without a great deal of difficulty, and one university had a plan underway to try that model on an experimental basis during the Spring 1987.

Comment and Recommendation: Both models have advantages and disadvantages. The charge-back model may tend to discourage reasonable use of the computer facility, and can place a hardship on students whose accounts run out during off hours. The library model requires careful monitoring by both computer center personnel and by faculty to discourage abuse. Many say that the library model presents the danger of wasting the resource, since everyone gets "unlimited" usage. Nevertheless, it is the opinion of the consultants that the access method provided should encourage the full use of the facility; it is recommended that each institution consider implementing the library model, at least on a trial basis.

SUMMARY OF CONSULTANTS' RECOMMENDATIONS

ON THE SYSTEMWIDE ISSUES

1. Each institution should consider a planned reorganization which will result in the designation of recognized degree structures at all levels, and suitable administrative location for their effective delivery. (Page 5)

2. The State University System should consider phasing out computer technology programs and redirecting those resources to the remaining three types of computer degree programs. (Page 7)

3. Institutions should monitor the needs of their constituencies to see that the Information Systems curricula being provided are suitable to and adequate for the need. (Page 9)

4. SUS computer science programs should be administratively situated in locations which foster continued quality and also the professional development of the program faculty and of faculty in related disciplines. (Page 10)

5. All SUS institutions should be sensitive to the natural symbioses among computer science, computer engineering, and electrical engineering. They should design the administration of such programs to foster the interaction of these faculties, facilities, and curricula. (Page 11)

6. Each university should examine its master's curriculum to see that offerings allow all students to select both theory and applications which are appropriate to their particular degree objectives. Planning for master's programs beyond those currently proposed should not be on the horizon prior to the next review. (Page 12)

7. The SUS should concentrate on the development and strengthening of existing Ph.D. programs, and should consider initiating new programs only when in a position to see that those can be started with sufficient faculty, student and equipment resources to be of high quality from the outset. The primary Ph.D. need, statewide, presently is for Computer Information Systems. (Pages 13 & 15)

8. The Board of Regents should encourage the accreditation of computer degree programs in the SUS. (Page 17)

9. Each SUS institution should reaffirm its commitment to recruit and retain highly qualified minority students. Graduate student recruitment efforts in general also need to be increased. (Page 21)

10. Florida should survey selected high quality institutions nationwide to determine the computer program teaching loads there--both number of courses and student enrollments. This data should be used to determine a suggested load for SUS computer program units. (Page 21)

11. Each SUS university should establish a research focus, and recruit faculty with expertise supportive of that focus. Each university should strive to acquire one or two established leaders in its program's area of focus, and use those to attract outstanding younger faculty. (Page 25)

12. At many SUS institutions, laboratory equipment associated with computer hardware courses is inadequate. Steps must be taken to provide proper support for this essential curriculum component. (Page 27)

13. Each institution should develop an internal catalog of sharable hardware and software; these catalogs should be available internally through Local Area Networks and throughout the SUS through the Florida Information Resources Network. (Page 28)

14. A joint student/faculty/industry advisory group should be formed by each institution to help guide curricular and programmatic development. (Page 29)

15. Established relationships with industry should be expanded to include cooperative efforts such as statewide conferences and symposia. (Page 31)

16. Each SUS university should develop and provide comprehensive continuing education opportunities for local computer professionals. (Page 32)

17. Each university computer program unit should work with local school districts and the College or School of Education to develop special training programs leading to certification for in-service public school teachers of computer science. (Page 33)

18. Each SUS university computer program unit should establish agreements whereby its primary feeder community colleges would be encouraged to offer introductory major coursework in computer science which would then transfer into the university's program. (Page 34)

19. A full degree program should be offered at a branch campus only when the university has a core of full-time faculty in the discipline located permanently at the branch, and provides adequate equipment support to assure that the branch offering maintains the quality achieved by the main campus operation. (Page 36)

20. A computer access method provided should encourage the full use of the computer facility; each institution should consider implementing the "library" funding model, in which the computer services are funded off the top, and access fees are not charged to students and faculty. (Page 37)

UNIVERSITY OF FLORIDA (UF)

LOCATION:	Gainesville	
DEPARTMENT NAME:	Department of Computer and Information Sciences	
COLLEGE:	College of Engineering	
DEGREES OFFERED:	BSBA	Computer Information Science College of Business Administration
	BS	Computer Information Science College of Liberal Arts
	BSE	Computational Information Sciences College of Engineering
	MS	Computer Information Science College of Business Administration
	MS	Computer Information Science College of Liberal Arts and Sciences
	MS	Computer and Information Engineering Sciences College of Engineering
	ME	Computer and Information Engineering Science College of Engineering
	PhD	Computer and Information Engineering Science College of Engineering

BACKGROUND.

The Department of Computer and Information Sciences offers programs leading to degrees in the Colleges of Engineering, Business, and Arts & Sciences. It has a unique arrangement whereby the components of its curriculum are approved by the appropriate College, as well as by the University Curriculum Committee.

The administrative arrangement of the UF CIS department was developed prior to the 1978-79 review, and has continued, despite that review team's concern that such an arrangement would hamper the development of graduate

programs and tended to restrict the quality that could be achieved. Those consultants also indicated that the curricula then being offered needed stronger theoretical components, that section sizes were too large, and that academic advisement should be improved. An important conclusion of that review was that the weaknesses resulted from compromises required to implement programs in three colleges, with one faculty body.

Since that review, there has been an increase in the theoretical components of the curricula, and a full-time advisor with much-needed secretarial support has been added. A great deal of improvement has been made; however, there are still areas where more can be done.

The department has almost 650 undergraduate majors and 130 graduate students (28 in the Ph.D. programs). The undergraduate majors are predominantly in the engineering and business tracks of the program.

There are currently 17 regular faculty and 3 visiting assistant professors. There are also twenty-five graduate teaching assistants.

PROGRAM STRENGTHS.

- The consultants are impressed with the quality of faculty.

- The computing equipment is quite good, and is easily accessible both by students and faculty. This is particularly true of equipment in support of instruction.

- The excellent new engineering building provides a superior facility for the program.

- The department has strong research capability in the areas of database management systems and software engineering. The new research centers being established at UF in those areas have great potential.

- The department has excellent relationships with industries in Florida. Many departmental courses are available throughout the State through the FEEDS network; those are highly regarded by the industry representatives interviewed.

OPPORTUNITIES FOR IMPROVEMENT.

- The department should enhance its research focus and strength by adding further expertise in areas such as artificial intelligence, image processing, and computer architecture.

- The department is viewed primarily as a service department by industry. This image can be improved through the recruitment of new faculty and an increase in the departmental research emphasis.

- The current curricula would benefit from yet stronger theoretical components. The level of mathematics content in the Computer Science and Computer Engineering programs should be increased.

- The faculty should be given the opportunity to increase their research efforts. Additional faculty will be required to allow for the moderate teaching responsibilities that full-time, outstanding researchers can be expected to assume.

- The academic quality of the undergraduate students is very good; however, their motivation could be improved. Direct faculty counseling, both at the undergraduate and graduate levels, would help in this regard.

- Closer articulation with the community colleges would allow for some coursework to be moved to the lower division and thereby allow more room for upper division major work.

- Upper division classes taught by graduate assistants would be improved by having full-time teaching faculty supervise their teaching and monitor course content very closely.

SPECIFIC RECOMMENDATIONS.

1. Separate the Computer Information Science Department into two distinct components; one component to provide computer engineering and computer science offerings, and the other to provide the computer information systems curriculum. This will provide better degree identification and will help to strengthen the curricula of all three colleges' computer degree programs.

2. Once these departmental components have stabilized, take steps to establish a School of Computer Science and Computer Engineering within the next five years. This should be not only a strong teaching entity, but also an outstanding research component for the University.

3. Develop plans to offer the authorized Ph.D. in the area of computer science through the College of Arts and Sciences. This is preferred to offering a Ph.D. degree through an engineering college to a non-engineering undergraduate major.

4. The computer engineering undergraduate component has been accredited. The other CIS components should seek accreditation as they can be made ready.

5. All the undergraduate core courses should be taught by regular, tenure-track faculty, and not by teaching assistants and adjuncts.

6. The review team was impressed by the eagerness of the Florida industries to help the University with research support, fellowships, etc. The Department should capitalize on this relationship by encouraging support for colloquia and faculty travel.

7. Improve minority and disadvantaged student recruitment efforts, particularly in the computer programs leading to degrees in Arts & Sciences and Business.

8. Hire a strong, research-oriented Department Chairman and recruit research leaders to provide additional advice on the structure and development of the graduate and undergraduate programs.

9. Keep striving to improve the access to the mainframe computing facility and establish more workstations for students and faculty. Remote access, local area networks, software and hardware sharing all must be made available and maintained at state-of-the-art levels.

FLORIDA STATE UNIVERSITY (FSU)

LOCATION:	Tallahassee
DEPARTMENT NAME:	Department of Computer Science
COLLEGE:	College of Arts and Science
DEGREES OFFERED:	BS Computer Science MS Computer Science PhD Computer Science

BACKGROUND.

Since the last BOR review, a new Computer Science Department has been created from the Computer Science Program, which had been a part of the Mathematics Department. The new Department is in the College of Arts and Sciences, and has been given great deal of strong support in terms of faculty hiring, research and teaching loads, and program development.

The program has about 600 undergraduate majors, and 94 graduate students. There are ten faculty teaching in the program. The majority of the faculty are research-oriented with a strong focus in the rapidly emerging areas of artificial intelligence (AI) and software engineering.

The previous review concentrated on the administrative location of the program, and urged its separation from mathematics. That had been accomplished by the time of this review.

PROGRAM STRENGTHS.

- The review team was impressed by the high quality of the research program, and the dedication of the faculty towards both research and teaching.

- The predominantly theoretical curriculum is quite strong, and is well founded mathematically.

- The graduate program is strong in the specialized areas of theoretical AI and software engineering.

- The students appear to be very bright, and well-satisfied with their programs; FSU has very good articulation with nearby community college programs.

- Faculty research productivity is excellent, as is suitable for a strong graduate university. The teaching load of three courses per year appears to be satisfactory to sustain the goals of both good graduate education and a good research program.

- The Department has good interaction with strong Departments like Mathematics, Physics, and Meteorology.

- The new SuperComputer Project promises to enhance the research and graduate program of the Department.

OPPORTUNITIES FOR IMPROVEMENT.

- The space needs of the department are critical. There is not enough laboratory space, faculty office space, or graduate student office space. The computer terminals are scattered in several buildings around the campus, which creates great inconvenience both to the students and to

the faculty. Several graduate teaching assistants are lodged in a remote wooden shed a great distance from the departmental offices. On the average, an FTE faculty is assigned only 96 square feet of office space.

- Space problems impede the acquisition of much-needed laboratory equipment for both undergraduate and graduate teaching.

- The minority and women student enrollment in the graduate programs could be increased.

- The Department has only two full-time administrative and support staff. This is very limited for an operation of this size. Also, laboratories and research equipment need to be maintained, and this implies the need for maintenance support personnel and equipment.

SPECIFIC RECOMMENDATIONS.

1. It is recommended that immediate and urgent attention be focused on alleviating the space problems.

2. The computing resources all should be located in close proximity to one another for the convenience of the students. The hardware lab for the undergraduate logic design courses should be supplied with state-of-the-art instructional devices. Computer labs should be open for longer hours for student accessibility, and remote dial-up facilities should be expanded.

3. The Department and the College should increase their investment and undertake new initiatives to expand minority and women enrollment.

4. It is strongly recommended that more balance be established in the curriculum by adding additional courses and laboratories that emphasize practice.

5. The graduate degree program being proposed by the SuperComputer Research Institute has potential for having adverse impact on the Computer Science degree programs--through redirecting faculty, resources, and products away from existing programs. A comprehensive study of the program should be undertaken, with the participation of the Computer Science Faculty, before any further commitment be made.

FLORIDA AGRICULTURAL AND MECHANICAL UNIVERSITY (FAMU)

LOCATION:	Tallahassee
DEPARTMENT NAME:	Division of Computer and Information Systems
COLLEGE:	College of Engineering Sciences, Technology, and Agriculture
DEGREE OFFERED:	BST Data Processing Technology

BACKGROUND.

The historical emphasis of FAMU has been to prepare minority students for a variety of professional and service occupations, and the current computer curriculum has been developed with this occupational focus in mind. As noted in the self-study, the graduates of the curriculum have contributed significantly to the representation of minorities in computer-related fields; FAMU graduated 61 Black computer specialists in 1985, while the other eight state universities graduated only 34.

The Data Processing Technology program began in September 1967 as a two-year program in the Vocational-Technical Institute, and is now a four-year program offered by the Division of Computer and Information Systems (CIS) in the College of Engineering Sciences, Technology and Agriculture. Since the program review of 1978-1979, the full-time faculty have increased from two to seven, and the number of majors has increased from 142 to approximately 300. In that time period, 200 students have earned the Data Processing Technology degree. According to the self-study report, FAMU CIS graduates typically earn the highest starting salaries of any FAMU graduates and are employed in more than one dozen Fortune 500 companies.

The 1978-79 review indicated that the curriculum needed streamlining (including the replacement of the technology degree with a B.S. program), the program was understaffed (both in faculty and in support staff), the curriculum was too job-oriented, and that a graduate program should not be considered until major improvement was made in the undergraduate program. The previous review team also recommended that the administration keep aware of shifts in the direction of technology and of the job market, and to redirect resources correspondingly.

FAMU has not made much progress in implementing those suggestions. Although the staff has been increased noticeably, the student load also has increased proportionally. The curriculum still needs to have its occupational focus reduced, and the technology degree is still the one being offered.

The faculty have many serious concerns about the curriculum, the organizational structure, and administrative problems. Foremost among those concerns are lack of graders or teaching assistants, and time to research and/or publish. Only two of the six faculty are tenured, whereas the College has 80 percent of its faculty on tenure. The number of faculty relative to students and courses is very small. Finally, there is minimal support for faculty development.

The student concerns included access to terminals, and the availability of academic advising.

PROGRAM STRENGTHS

- The CIS Division is the largest among the academic units on campus, with 300 majors, 100 general students, and 500 service students.

- Current students and alumni are proud of their program; graduates appear to be successful in the workplace.

- The faculty are confident of their ability to offer a high quality program, and seek to implement improvements that they have developed to enhance the program.

- Faculty demonstrate a strong Divisional interest in the success of their students.

- The Division has a good articulation record with the community colleges.

- The recent addition of micro-computer hardware and terminals to the main-frame computer has enhanced the quality of hands-on instruction.

OPPORTUNITIES FOR IMPROVEMENT.

- With new leadership in the Division and the Administration, FAMU should explore the curriculum carefully, including inter-disciplinary relationships, and service course responsibilities.

- FAMU should take steps to upgrade the quality of its program and faculty and move the curriculum away from data processing technology toward one of the standard models for computer degree programs. The image of the program to prospective students and to employers will be enhanced with this change.

- Strengthening the program will help improve the level of placement of students as they enter the workplace. Higher placement for the current graduates and the role this plays in the goals of future graduates is not to be underestimated. Striving for advanced placement of each graduate will enhance the image of quality of the program for employers.

- The quality of the program can be addressed better if more information on the current graduates and on the graduates of earlier program years is collected. Such information should include impressions of students' opportunities for advanced entry-level jobs and for additional educational pursuits.

- FAMU students have a strong desire to enter the workforce as soon as they complete their baccalaureate degrees. The Division might do some of these students a service by encouraging them to explore the opportunities for further education. This would increase their potential for advancement, and at the same time improve the pool of minorities available for careers in higher education.

SPECIFIC RECOMMENDATIONS.

1. Develop an Information Systems curriculum along the lines of the DPMA model curriculum, and replace the Technologies degree with a B.S. in Computer Information Systems.

2. Move the computer degree program out of its present college into the School of Business, or make it a stand-alone unit.

3. Initiate an annual survey of program graduates, beginning with the 1986 graduates, to determine their level of satisfaction with their degree programs and the opportunities those programs have provided, both in industry and in further education.

4. Reduce teaching loads by consideration of reallocating faculty positions to where the enrollment is; and increase support for advisement to further lighten the burden on faculty.

5. Increase support for faculty development, and for faculty to engage in research and travel to professional conferences and meetings.

6. Do not consider developing a graduate program until improvements in the undergraduate curriculum have been implemented and have had time to stabilize.

UNIVERSITY OF SOUTH FLORIDA (USF)

LOCATION:	Tampa	
DEPARTMENT:	Department of Computer Science and Engineering	
COLLEGE:	Engineering	
DEGREES OFFERED:	BET	Computer Technology
	BS	Computer Engineering
	BS	Computer Science
	BS	Information Systems
	MS	Computer Science
	MS	Computer Engineering
	PhD	Computer Science and Engineering

BACKGROUND.

A separate department of Computer Science and Engineering was established at USF in the Spring of 1980; the Bachelor's, Master's, and Ph.D. programs listed above have been added to the degree offerings since that time. The computer engineering bachelors program is ABET accredited, and the department is seeking CSAB accreditation for its Computer Science bachelors program. The Information Systems program is fundamentally the same as the computer science program, but with a few more business elective courses.

The University of South Florida has progressed a great deal since the 1978-79 review. The Bachelor of Technology degree in Computer Technology still exists in the College, but the new Department of Computer Science and Engineering has more than 700 undergraduate students and more than 100 graduate students; the new programs have obviously prospered. There are now fifteen faculty.

The undergraduate curricula all have a strong orientation toward applied science and engineering; the graduate curricula are evolving as new faculty join the department.

Tampa has become one of the most rapidly growing areas of Florida. Many industries have settled in the area, among them the computer science and life insurance industries. This influx of industry has led to a growing demand for graduates of the various USF computer degree programs.

PROGRAM STRENGTHS.

- USF has made great strides since the last review, both in organizing and managing its programs and in providing resources to them.

- The department has a number of young, dynamic faculty. The acting Chairman promises to be a stabilizing force in the department. The new College Dean is enthusiastic and supportive.

- There appears to be excellent collaboration with local industries, the university's involvement in FEEDS courses is particularly appreciated by nearby businesses.

- The undergraduate computer science and computer engineering curricula are reasonably well-balanced, patterned after the IEEE computer society curriculum recommendations.

- The new engineering building provides excellent facilities and equipment in support of the programs, particularly at the undergraduate level.

OPPORTUNITIES FOR IMPROVEMENT.

- The Department of Computer Science and Engineering needs permanent leadership. In the past two years, there have been two interim chairmen in the Department. This turnover puts too much strain on the faculty, and demands that each new chairman start the learning process anew.

- The teaching load of the faculty, including the service requirements, appears to be more than the average. The large classes, a large variety of courses, and the small number of faculty restricts research activity, as well as other productive activities, e.g., publishing.

- Even though the Department awards graduate degrees through the Ph.D., it has not developed a research focus. The faculty are heterogeneous; a critical mass of faculty in any particular research area is yet to be achieved.

- Core courses are being taught routinely by adjunct professors from industry. It would be better to have core courses taught only by full-time faculty who have a full understanding of the curriculum.

- Additional instruction and research equipment, particularly in graphics and hardware laboratories, would greatly enhance the program.

- Although the applications and practical aspects of the curriculum are quite strong, additional theory classes would be desirable. A greater balance could be attained between theoretical and applied computer science courses.

- Some off-campus classes require faculty involved in such instruction to commute long distances to teach. Although they receive additional compensation for this, they are involved out of responsibility to the university rather than monetary concerns; and the duty may interfere with their scholarly work and on-campus activity.

RECOMMENDATIONS.

1. The colleges' first priority should be to find a strong research leader and permanent chairman for the Department.

2. Since the Department is awarding Ph.D. degrees, it must establish strong research focus, and recruit a critical mass of faculty to support that focus.

3. The Department should continue to seek CSAB accreditation.

4. Additional theoretical coursework should be incorporated into the computer science and computer engineering curricula. The Information Systems curriculum is far too scientifically oriented. If it is to be continued (see the following recommendation), it should incorporate more substantial business-oriented coursework.

5. The computer technology program should be phased out gradually and be supplanted by a Computer Information Systems program, developed in connection with, and perhaps situated in, the College of Business. Several model curricula have been developed for such a program.

FLORIDA ATLANTIC UNIVERSITY (FAU)

LOCATION:	Boca Raton	
COLLEGE:	College of Business and Public Administration	
DEPARTMENT:	Department of Computer and Information Systems	
DEGREES OFFERED:	BA	Computer Science
	BA	Computer Information Systems
	MAS	Information Systems
	MS	Computer Science
COLLEGE:	College of Engineering	
DEPARTMENT:	Department of Electrical and Computer Engineering	
DEGREES OFFERED:	MSE	Computer Engineering
	ME	Computer Engineering
	PhD	Computer Engineering
COLLEGE:	College of Science	
DEPARTMENT:	Department of Mathematics	
DEGREES OFFERED:	BS	Mathematics-CS Concentration
	MS	Computer Science
	MCS	Computer Science
	MST	Computer Science

BACKGROUND.

The region in and around Boca Raton has been growing at a very rapid pace as the population center of Southeast Florida moves northwards toward Palm Beach and Martin Counties. Local industry has created a strong demand for computer science and informations systems educational opportunities in the area; the University responded to this by adding a variety of degree programs in computer related areas that collectively fit the needs of the local industry. Immediately prior to this review, the University's Faculty Senate

approved a restructuring plan for the administration of these computing curricula. This plan was initiated because of a need to streamline the course and degree offerings to meet the needs of the Region and the State in a cost effective and efficient manner. The University engaged outside consultants to help them formulate this global restructuring plan.

The reorganization will consolidate computer programs from the College of Business and Public Administration, College of Engineering, and the College of Science. The first step to be taken will be to designate a core group of faculty from existing programs to clarify the mission and ultimate organization of the new unit. This group initially will report to the Academic Vice President.

Many persons interviewed expressed some apprehension about the effects of the reorganization on the budget, resources, research, etc.; however, they expressed a positive outlook for the ultimate benefits the reorganization could have for the FAU computer programs.

The Computer and Information Systems Department has 13 faculty with computer emphases. They presently handle about 130 FTE undergraduates and 35 FTE graduate student enrollments per year. The department graduates over 100 bachelors and 5-10 masters students per year.

There are eight Computer Engineering faculty. The graduate programs they offer are new, and have not produced graduates. FAU is considering the development of an undergraduate computer engineering degree program in the next few years.

The Mathematics Department offers a computer science track which has attracted 80% of the department's majors for the past few years. The eight faculty who participate in computer science instruction comprise about 3.5 FTE faculty dedicated to that discipline.

Under the proposed reorganization, some faculty from each of these units would be assigned to the new unit.

PROGRAM STRENGTHS.

- The local industries are pleased with the quality of FAU computer graduates.

- Local industry employees can pursue graduate degrees through a combination of classroom and FEEDS coursework.

- The University has recruited a number of very good faculty to the various computer programs over the years. The nucleus exists for the initial staffing of the reorganized unit.

- The Information Systems program still has the kind of strength that impressed the consultants in the 1978-79 review.

- The various curricula have all been developed using good curricular models.

OPPORTUNITIES FOR IMPROVEMENT.

- The new organization provides the opportunity to establish a strong, well-directed computer science/computer engineering interaction.

- The transfer of computer science faculty from CIS into the new unit will permit the CIS department to focus its attention on the Information

Systems curriculum local businesses and industry would like to see developed more fully.

- The transfer of computer science faculty from Mathematics into the new unit will allow the mathematics department to concentrate on the traditional mathematics curriculum, while providing mathematics course-work in support of the new unit's programs.

- The organizational structure at FAU has led to offering too many degree programs, the differences among which are unclear to those outside the university. The new organization can help remedy this.

- The research focus for graduate programs can be established as the new unit determines its missions and direction of development.

- Articulation with nearby community college programs can be improved by centralizing the computer program administration and streamlining the curricula.

RECOMMENDATIONS.

1. Designate the initial staffing of the new unit quickly, drawing suitable faculty from the existing three departments.

2. Give the new unit responsibility for developing undergraduate and master's degree curriculum options in computer science which are compatible with existing options, and eliminate the computer science programs from CIS and Mathematics.

3. Move the computer engineering masters program to the new unit, and have the new unit develop a proposal for a bachelors program in that discipline.

4. Eliminate unusual degree titles, e.g., Master of Applied Science, in favor of the more traditional ones, and use the names "Computer Science," "Computer Engineering," and "Computer Information Systems" to identify the programs.

5. Move to strengthen the Computer Information Systems programs by increasing the mathematical requisites and the coursework in areas such as database, networks, etc.

6. Make a concentrated effort to articulate the new unit's programs very closely with the nearby community colleges.

7. Do not move toward providing full program offerings at branch campus locations until resources are adequate that such a move will not jeopardize main campus delivery.

8. The Information Systems Program is a most important undergraduate program for the region. Its quality should be improved by requiring a stronger mathematics base. The graduate program in the current CIS department should be strengthened at the same time that the new unit is building its programs.

UNIVERSITY OF WEST FLORIDA (UWF)

LOCATION:	Pensacola
DEPARTMENT:	Department of System Science
COLLEGE:	College of Business
DEGREES:	BS Systems Science MS Systems Analysis

BACKGROUND.

The Systems Science Department was established in 1970 with 160 majors enrolled in two major options, scientific and business. Enrollment peaked in 1983-84 at over 750 undergraduate and graduate students; it had dropped to about 675 by 1986-87. This follows the national trend of declining enrollments, but is contrary to the overall enrollment patterns in computer programs in Florida, which are relatively stable. The curriculum is designed for the education of professionals to enter data processing and process control fields.

Since 1979, the department has resided within the College of Business. Not surprisingly, the Business Option students have comprised 80-85 percent of the undergraduate majors, over the years. Because of the growth in the number of students in the department from 1979 to 1984, it was a major challenge for the department to supply enough faculty to meet the student demand, even though the number of faculty were increased from six in 1976 to fifteen in 1986. The programs currently graduate over 200 Bachelors and 30 Masters students annually. The 1978-79 review recommendations included those consultants' concerns about the two diverse tracks in the program, and the consultants' feeling that the process control curriculum was misplaced in the

College of Business. They also expressed concern that the students in the scientific option were having difficulty finding employment (especially locally), and would continue to do so.

However, UWF has expressed interest in continuing its two options, and feels that both have value in serving the Pensacola region. In fact, because of the long-term involvement of UWF with the military and their process control emphasis, the department presently is exploring an affiliation with the Carnegie-Mellon based Software Engineering Institute.

PROGRAM STRENGTHS.

- Physical facilities and equipment available are ample, attractive, efficient, and accessible.

- Student success as based on the ability to obtain employment after graduation is good, with students in the business option experiencing the easiest route to their first jobs. Those students in the process control option indicate that it is more difficult to obtain employment in that specialization in the Pensacola area; in spite of that fact, they feel they are well-trained for employment. Nationwide prospects for graduates of both tracks is good.

- The undergraduate business option curriculum and the graduate science option curriculum are strongest of the four programs.

- Employer interest in UWF graduates indicates that businesses feel that the university is doing a good job in training entry-level computer professionals.

- Articulation with the local community college seems quite good.

OPPORTUNITIES FOR IMPROVEMENT.

- Planning for the computer curriculum needs to have a focus. What will the curriculum be in five years and what has to be done to move it in that direction? This focus can be provided by the aggregate of a number of sources, including the needs of employers of the graduates, recommendations of recent graduates, research interests and skills of the teaching faculty, model curricula, accreditation guidelines, certification requirements, academic residence of the program, and peer university programs.

- The names of the various degrees awarded do not describe the programs very well, particularly to people outside of the Pensacola area. This has not improved since the previous review, and still raises concern for students seeking employment outside of Pensacola or wishing to enter graduate study elsewhwere.

- Departmental communication lines and the communication links into university processes and activities do not always function as well as the faculty and administration would prefer. Decisions and methodologies concerning hardware and software procurement constituted a major faculty

concern during the consultants' visit, apparently because of miscommunication or the failure to communicate.

- In a heavy-course-load environment as at UWF, the research skills and interests of the faculty tend to atrophy. This is evidenced by the lack of scholarly productivity of the faculty. Reduced classroom assignments for the purpose of developing research interests, or industry contracts, or grant proposals, or new course content would be used advantageously by a large percentage of the faculty.

- The curriculum has been static for some time; the content of courses should be updated and new courses developed that reflect current business practices. Database, data communications, newer generation languages, and software used by local industry represent examples of content requirements mentioned by alumni and employers as being needed at UWF.

- The balance of theory and practice needs to be considered. Students in both the undergraduate and graduate program need to have association with faculty who are interested in and active with special research projects as well as with faculty who are attempting to supply the specialized knowledges and skills employers are requesting of students who are entering the workforce. The UWF curriculum would be improved if the theoretical content of the courses were increased.

RECOMMENDATIONS.

1. Seek an outstanding computer Information Systems expert to fill the new Eminent Scholars position. The 85 percent business-option/15 percent science-option distribution of majors in the program suggests that a business oriented person should be hired for this position.

2. Additional hiring at the lower academic ranks should follow the general guidelines given in the Systemwide sector of this report.

3. In the next five years, it is unlikely that the masters programs will grow significantly; therefore, the faculty should target improvement in quality as the major thrust. Actions that will tend to improve the quality include reduction of class sizes and teaching loads, and increasing faculty resources for research and professional development.

4. For both the bachelor's and the master's, develop the two curricular tracks and institute degree program names of Computer Science for the process control track and Computer Information Systems for the other track.

5. Continue to pursue the affiliation with the Carnegie-Mellon Software Engineering Institute (SEI); however, do not commit scarce university faculty resources to significant development or incorporation into the UWF curriculum of SEI curriculum modules.

UNIVERSITY OF CENTRAL FLORIDA (UCF)

LOCATION:	Orlando
COLLEGE:	College of Engineering
DEPARTMENT:	Department of Computer Engineering
DEGREES OFFERED:	BSE Computer Engineering MSE Computer Engineering MS Engineering Systems Analysis PhD Computer Engineering
COLLEGE:	College of Engineering
DEPARTMENT:	Department of Engineering Technology
DEGREES OFFERED:	BT Computer Technology
COLLEGE:	College of Arts and Sciences
DEPARTMENT:	Department of Computer Science
DEGREES OFFERED:	BS in Computer Science MS in Computer Science PhD in Computer Science

BACKGROUND.

The University of Central Florida's Department of Computer Science has developed from a program in mathematical sciences to a distinguished graduate department with an excellent research base. The Department of Computer Science has been developed through Center of Excellence funding provided by the State of Florida in 1978.

The programs have grown in quality and size since the 1978/79 review. The research program in Computer Science includes parallel processing, VLSI architecture, artificial intelligence (AI), computer vision, algorithms,

databases, and software engineering. The Computer Science Department ranks among the second quartile in the U.S. It has an Eminent Scholar position and a high quality faculty. There are 24 faculty. The department has 850 undergraduate majors, 85 Masters and 7 Ph.D. students.

The Department of Computer Engineering is based in the College of Engineering. Its focus is in the areas of signal processing, architecture, simulation technology, software engineering and expert systems. The department has 8 faculty. There are 256 undergraduate majors and 109 graduate students in the department.

PROGRAM STRENGTHS.

- Both the Computer Science and Computer Engineering programs have dedicated faculty that are concerned with quality teaching and with the continuing development of strong research activity. Most of the faculty members are active in research, and many are involved locally and/or nationally in professional activities.

- Enrollment in both programs is strong and stable. Student quality appears to be good to excellent at the undergraduate and masters levels.

- Graduates of the program are highly regarded by local industries, and job opportunities seem to be excellent. Moreover, the programs enjoy a good relationship with local industries and governmental organizations through research and consulting activities.

- The computer engineering program is currently one of only thirty-six such programs in the nation accredited by the Accreditation Board for

Engineering and Technology (ABET) and was one of the first such programs ever accredited.

- Space allocations for the programs are excellent at the present time in both quantity and quality, although additional space will be needed as research activities grow.

- Laboratory equipment is good to excellent in many areas including digital systems, microprocessors and microcomputers, embedded computer systems, and personal computers. The plan to install a local area network for the College of Engineering in the Spring of 1987 is a positive step.

OPPORTUNITIES FOR IMPROVEMENT.

- There is a rivalry between Computer Science and Computer Engineering that leads to course and research overlap, which must be coordinated. Reduction of the duplication will be beneficial to both Departments. There must be more coordination with other departments, such as Physics, Electrical Engineering, and Mathematics as well.

- Equipment acquisition has produced an adequate but heterogeneous amount of equipment. The maintenance requirements and lack of service contracts for this equipment present special problems for both departments.

- Since Computer Science is a limited access program, there is concern about how minority and disadvantaged students have been accommodated. There need to be improved programs to encourage minorities and disad-

vantaged students to access the Computer Science and Computer Engineering programs.

- The graduate student quality in both programs could be improved at the doctoral level. This might be accomplished by providing more and higher awards for assistantships, fellowships, scholarships, etc.

RECOMMENDATIONS.

1. Develop a plan to analyze the feasibility of and alternatives to joining the Computer Science and Computer Engineering programs in a separate academic unit. A closer relationship will enhance the interaction among the two faculties and will help control the duplication and rivalry that presently exists. Alternatives could include joint appointments, joint course listings, and a committee to investigate course content duplication.

2. The Computer Science and Computer Engineering departments need more faculty members in specific, targeted research areas. A critical mass of faculty is required for truly effective research in an area of departmental focus. Each department should develop a focus and concentrate on strengthening a few areas of directed research that will result in collaboration industry as well as with other departments.

3. The University should embark upon an extensive public information effort to describe the potential and promise of the programs for students and industry.

4. The theory component of the Computer Science program was materially enhanced with the appointment of the distinguished chairman. This should be further enhanced with the addition of young new faculty to teach the core theory courses.

5. The Computer Technology program should be phased out gradually, and be replaced with a Computer Information Systems program, developed in conjunction with, and perhaps located in, the College of Business.

FLORIDA INTERNATIONAL UNIVERSITY (FIU)

LOCATION:	Miami	
COLLEGE:	College of Arts and Sciences	
DEPARTMENT:	Mathematical Sciences	
DEGREES OFFERED:	BS	Mathematical Sciences
	MS	Computer Science
	PhD	Computer Science

BACKGROUND.

Florida International University is located in the most heavily populated area of Florida, Dade County, in a region strong in hospitality and business service industries.

The Computer Science faculty are a portion of the Mathematical Sciences Department, which also houses mathematics and statistics programs. The computer science program is very large; there are 700 undergraduate majors, about sixty in the M.S. program, and fifteen in the Ph.D. program. There are presently fifteen computer science faculty.

Since it is a metropolitan institution in a heavily industrialized region, there are many part-time students, both in the undergraduate and graduate programs. This heavy proportion of part-time students makes curriculum coordination and the development of program quality a challenge--particularly at the graduate level. Nevertheless, it was noted in the 1978-79 review that the curriculum requirements are generally good. The undergraduate curriculum is similar to the ACM model; however, it appears to lean towards the mathematical and theoretical aspects and underemphasize the practical coursework. This may be a consequence of being a part of a mathematics department.

The previous review team suggested that FIU might consider developing a computer information systems program if one were not implemented in the College of Business. The College of Business has a Management Information Systems program; however, it has very little computing coursework associated with it.

The master's program is just beginning to produce graduates, and the Ph.D. program has only one year of operation behind it. About half of the fifteen computer science faculty are actively engaged in research, and four or five would be in a position to direct doctoral candidates. Departmental research is software-oriented.

Some teaching faculty felt that although they were hired as teachers, they are now experiencing increased pressure to do research and publish; however, this is a natural consequence of developing a Ph.D. program. The consultants noted that FIU's Ph.D. program appeared to be administered as a standalone rather than affiliated doctorate.

PROGRAM STRENGTHS.

- The baccalaureate program includes a strong theoretical core component.
- The program has a very high minority representation; the department has supported minority faculty as they pursued the terminal degree, as well.
- The department has several well-qualified, productive faculty members.
- There seems to be good articulation with some programs in the nearby community college.

OPPORTUNITIES FOR IMPROVEMENT.

- The Ph.D. program lacks strong supporting departments like mathematics and electrical engineering. This makes recruiting of research-oriented faculty more difficult.

- There is no established focus for the Ph.D. program; and no real core of research faculty in closely-related areas.

- Undergraduate and graduate programs both would benefit from additional computer engineering, hardware, and architecture-oriented content.

- The undergraduate program needs more state-of-the-art practical content.

- Full-time graduate students are essential to the success of graduate programs. More attention needs to be directed to recruiting such students.

- The location of the programs in what is viewed as a mathematics department causes degree identification problems, and hampers the development of programs.

- The Computer Information Systems needs of the Miami area sould be addressed more fully by FIU.

RECOMMENDATIONS.

1. Establish a Department of Computer Science, and move the computer programs out of the Mathematical Sciences Department.

2. Be selective in the recruitment of new faculty to ensure that their research and teaching interests relate to the software needs of the region. In the recruitment process, advertise the selected Ph.D. research focus of the department, and advertise for teams of applicants.

3. Work with the University of Miami to enhance the computer engineering, hardware, and architecture content of the curriculum.

4. Increase the number and dollar amount of assistantships, fellowships and scholarships to entice more full-time M.S. and Ph.D. students.

5. Increase the motivation for the tenured faculty to become active in research appropriate to the needs of the new department.

UNIVERSITY OF NORTH FLORIDA (UNF)

LOCATION:	Jacksonville	
COLLEGE:	None	
DEPARTMENT:	Division of Computer and Information Sciences	
DEGREES OFFERED:	BS	Computer and Information Sciences: Computer Science Track Information Science Track Information Systems Track
	MS	Mathematical Sciences: Computer Sciences Track

BACKGROUND.

The Division of Computer and Information Sciences was created in 1983 to consolidate the computer programs at UNF into one administrative unit. At that time, UNF offered a Bachelor of Technology in Information Systems Technology, a Bachelor of Arts or of Science in Mathematical Sciences with a computer science track, and was developing an Information Systems program in Accounting Information Systems. In the 1978/79 review, the consultants had recommended that the program in mathematics be changed and that an information systems program be developed; the technologies and business programs responded to the latter suggestion.

The Division has eleven full-time faculty, all of whom have Ph.D.'s (three in Computer Science). There are over 300 majors, and the Division currently awards approximately thirty degrees a year. The Technologies degree program has been phased out, although UNF is still authorized to offer it. The Computer Science track in the undergraduate Mathematical Sciences program has been phased out also, and the graduate Computer Sciences track in that department may be eliminated once the Division has its own masters program.

UNF was an upper division university until 1984, and did not have resident students until 1985. Consequently, it has a very high percentage of part-time students. That ratio should decrease as the lower division grows.

PROGRAM STRENGTHS.

- The faculty are, on the whole, young, ambitious, concerned about the program, and dedicated teachers.

- The program receives high priority from the UNF administration.

- The program is very responsive to local community needs.

- Equipment, for the most part, is sufficient for the programs being offered. Student access to computing is good.

- The curriculum is balanced between theory and applications.

- The Division has established excellent community college articulation arrangements.

OPPORTUNITIES FOR IMPROVEMENT.

- The variety of courses the Division seeks to offer, and the number of sections required to satisfy student demand, place a heavy burden on the faculty. This hampers efforts to do research and to remain up-to-date in the discipline.

- Hardware laboratory space and associated equipment is insufficient to support the hardware component of the curriculum.

- The need for both an Information Science track and an Information Systems track is unclear.

- Strengthening of the theory aspects of some advanced course work would provide better preparation for graduate study.

RECOMMENDATIONS.

1. The proposed M.S. in Computer and Information Sciences is a good program, and is much needed in the Jacksonville area. However, the program as proposed is too ambitious for the Division to implement successfully. A detailed plan for restricting the offerings and for phasing in the program slowly should be developed prior to seeking implementation approval.

2. The Division requires additional faculty to maintain their undergraduate offerings--the existence of a new master's program will exacerbate the teaching load situation. Enrollment restrictions and a cutback in course offerings should be considered if additional faculty cannot be obtained.

3. Additional software for the mainframe should be obtained in support of the Division's programs. Large scale database software and fourth-generation languages are examples of some needs.

4. Strengthen the curriculum of the Information Systems track in the direction of the current Information Sciences track, and phase out the latter one. This will allow for better scheduling, fewer course offerings, and better use of faculty. It also will bring the program names into ones with greater name-recognition.

5. Enhance the advanced computer science coursework by adding hardware support for Algorithm Theory and Computer Architecture courses. Make artificial intelligence and expert systems courses available to the Information Systems track majors.

APPENDICES

I. BOR CONSULTANTS -- BRIEF VITAE

PROFESSOR C. B. RAMAMOORTHY

Professor C. B. Ramamoorthy is currently a professor of Computer Science and Electrical Engineering at the University of California at Berkeley. He was a professor and department chairman at the University of Texas, Austin. His industrial experience includes 15 years service as senior staff scientist with Honeywell where he helped develop the company's first transistorized computer, the H-290.

Professor Ramamoorthy has served with distinction in many of the IEEE Computer Society activities. He has served as vice-president, member of governing board, and editor-in-chief of the IEEE Transactions on Software Engineering. He has chaired committees that developed Computer Science and Engineering model curriculum and Computer Engineering Accreditation guidelines.

Professor Ramamoorthy has authored over 100 papers, has directed over 25 Ph.D. students, has written or edited three books, holds seven patents, is an IEEE fellow, and has received two computer Society awards and citations from the computer societies or governments of Japan, South Korea, Taiwan, and West Germany.

He has served as a member of our SUS Academic Program Review Team in 1978.

Roland (Rollie) D. Spaniol
June, 1986

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CURRENT ACTIVITIES:

Professor of information sciences at Eastern Illinois University in the College of Business. Teach systems analysis and design topics to student majors.

Installed and maintain the computers for the City of Charleston. This includes supervision of the hardware and software.

Work with small businesses, municipalities, and educational institutions relative to their information systems needs.

First and Immediate Past-President of the Association of the Institute for Certification of Computer Professionals (AICCP).

Chairman of the Recertification council of the Institute for Certification of Computer Professionals (ICCP).

Immediate Past International Director of the Data Processing Management Association (DPMA) for 19 years.

Member of the Board of Directors of ICCP, representing the Association for Educational Data Systems (AEDS).

Facilitator for the Management Assistance Program of DPMA on topics including communications, goals and objectives, problem solving, decision making, leadership, managing change, and managing time.

National Lecturer for the Association for Computing Machinery (ACM) on topics relative to certification of computing professionals and disaster planning for computing.

PREVIOUS ACTIVITIES:

Designed and implemented the information sciences curriculum for the College of Business at EIU in 1965.

Director of Computer Services at EIU for thirteen years. Responsibilities included administrative, instructional, research, and public service computing.

Active for eight years as a member of the public university groups in Illinois that formed the Mid-Illinois Computer Cooperative (MICC), the Educational Computing Network (ECN), and the Illinois Educational Consortium (IEC).

Formed and then became first president of the Data Processing Management Association Education Foundation (DPMA-EF).

Two term president of the ICCP.

Formed the AICCP and then became first president.

Various consulting engagements and audits of computing operations in colleges and universities.

ACCOMPLISHMENTS:

Certified Systems Professional (CS), 1985

Ph.D., University of Iowa, 1967

Beta Gama Sigma, Business Honorary Society, 1966

Certificate in Data Processing (CDP), 1965

Delta Pi Epsilon, Business Honorary Society, 1962

Master of Science in Business Education, Illinois State University, 1956

Bachelor or Science in Business Education, Illinois State University, 1953

II. CAMPUS CONSULTANTS

CAMPUS CONSULTANTS

UWF

Dr. James P. Rozelle
Computer Information Systems Department
College of Business
Georgia State University

UNF

Dr. Roger Lamprey
Department of Mathematics and Computer Science
Valdosta State College

UCF

Dr. William Carroll
Computer Science Engineering Department
University of Texas at Arlington

Dr. S. Rao Kosaraju
Computer Science Department
Purdue University

III. CAMPUS COORDINATORS

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University Coordinators

COMPUTER AND INFORMATION SCIENCES

UF	Dr. Roger Elliott Professor Department of Computer and Information Science
FSU	Dr. Abraham Kandel, Chairman Computer Science
FAMU	Dr. Malcom Barnes, Coordinator Computer and Information Systems
USF	Dr. Murali R. Varanasi Associate Professor Computer Science and Engineering Department
FAU	Dr. Neal Coulter, Chairperson Computer Systems
UWF	Dr. Theodore Elbert, Chairman Department of Systems Science
UCF	Dr. Larry Cottrell, Professor Department of Computer Science
FIU	Dr. Robert C. Fisher Department of Mathematical Sciences (now Director, School of Computer Science)
UNF	Dr. Kenneth Martin, Director Division of Computer and Information Sciences

IV. REVIEW TIMESCHEDULE

SIGNIFICANT DATES IN THE REVIEW

Consultant Orientation	October 20, 1986
Campus Visits	
FSU	October 20-21
FAMU	October 22
USF	October 23-24
UWF	October 27
UCF	November 12-13
UNF	November 14
FAU	November 17
FIU	November 18
UF	November 24-25
Program Committee Workshop	April 30, 1987
Board of Regents Action	May 15, 1987

V. REVIEW ISSUES: SUMMARY

SUMMARY OF ISSUES IDENTIFIED
COMPUTER SCIENCE PROGRAM REVIEW

(a) The 1978-79 Computer Science Review.

What is our present status relative to the recommendations in that report? Have we been moving in the right direction? Are there further components of those recommendations we should strive to carry out?

(b) New Programs, and Accreditation of Programs.

What new degree programs are being thought of in the System? What is the potential impact of new programs on the existing ones? Are there quality issues involved? Should accreditation be sought for existing programs, and potential for accreditation a criterion for evaluating new or proposed programs? If so, what sort of accreditation, and what kind of time-frame?

(c) Supply/Demand: Students.

Is our (qualified) student supply relatively stable? Do we need to alter our recruitment strategies? Is ample minority opportunity being provided? What are the differences between the undergraduate and graduate pools, and are we well-positioned to accommodate the anticipated population mix in our programs? Are our graduates still finding opportunities for desired employment or further education to be favorable? Are we able to provide the graduating computer science major with the level and types of skills appropriate to tomorrow's market?

(d) Supply/Demand: Faculty.

What is the present availability of qualified faculty for our programs, and what faculty recruitment strategies can be undertaken to optimize our opportunity to obtain new faculty best-suited to our programs?

(e) Equipment.

What strategies can we employ to help ensure that the equipment required to keep our programs at the forefront of the discipline is being acquired and well-maintained? Should there be a systemwide pol[illegible] this issue? What types of access to computing is reasonable to p[illegible]de - for non-majors as well as majors? Should equipment dedicated to research be funded primarily through external sources?

(f) Professional Activity/Curricula Currency.

How do we provide continuing professional development opportunities to our faculty, particularly those whose original discipline was not computer science and who may require continuing retraining in order to maintain currency in such a rapidly-evolving curriculum? Do our programs have an appropriate balance of theoretical and applied coursework?

(g) Relationships with Industry.

What are we doing to enhance the public/private partnership concept through the discipline? What more can we / should we be doing in this regard?

(h) Teacher Education/Continuing Education.

Are there special steps we should take to provide course opportunities for teachers preparing for certification in computer science? What about special-application coursework such as is sought by some business interests? Should there be advanced seminars for professional practitioners who need continuing education to remain at the forefront of the discipline and who may not be degree-seeking?

(i) Computing Across the Curriculum.

Is the possibility that computer science courses can spread throughout the campus (much like statistics courses have) a cause for concern? Does this dilute our resources and impinge upon the quality of the programs we deliver? What kinds of organizations for delivery are suitable for our institutions?

(j) Articulation - program direction.

As computer science evolves and more intensive training becomes essential to professional entry, how can we articulate best with the lower division preparation in the community colleges. Are there program components the SUS should leave for the community colleges to provide?

(k) Branch Campuses.

What is the impact of providing branch campus offerings in a high-demand high-cost discipline like computer science? Should such offerings only be provided when cost effective, or are there other circumstances under which they can be justified?

(l) Funding.

Should there be a differential funding mode for computer courses, e.g. the library model, in order to provide adequate resources and the flexibility needed to fulfill the discipline's obligations?

VI. SPECTRUM OF COMPUTER DEGREE PROGRAMS

I. THE COMPUTER SCIENCES IN FLORIDA'S UNIVERSITIES

STATUS AND NEEDS FOR THE '80's

Excerpts from the 1978-79 Review of Computer Sciences

> "In particular, it is likely that the role played by computer science in behavioral and social sciences, the professions, and the humanities will be similar to that played by mathematics in the growth of the physical sciences."
>
> S. Amarel
> Encyclopedia of Computer Science

The Computer Sciences

The computer sciences cover a very broad range of intellectual and every day life activities. Figure 1 attempts to show this breadth from several levels and perspectives (without getting into too much detail). It is by no means complete but to carry it much further would be courting obfuscation. Only a casual look at "The Computer Sciences Spectra" is necessary to confirm the statement made by Dr. Orrin Taulbee during one of the team's visits that "Computer Science comes in many flavors." The paragraphs used in the Encyclopedia of Computer Science to describe "Computer Science" offer further evidence of the broad spectra of the computer sciences:

> "Computer science is concerned with information processes, with the information structures and procedures that enter into representations of such processes, and with their implementation in information processing systems. It is also concerned with relationships between information processes and classes of tasks which give rise to them."

> "The main objects of study in computer science today are the digital computer and the phenomena surrounding it. Work in the discipline is focused on the structure and operation of computer systems, on the principles that underlie their design and programming, on effective methods for their use in different classes of information processing tasks, and on theoretical characterizations of their properties and limitations."

For the purposes of this paper we will discuss only one of the several spectra of the computer sciences. Other spectra such as topical and course packaging are treated in the following references (1,2,3,4,5) in some detail. Of primary concern in this discussion are the names and descriptions of degree programs. There is a consensus among computer science educators that any degree program and/or department carrying the title Computer Science must include what is generally referred to as the "core" area in the computer sciences, namely, computer systems and languages. If the faculty and offerings do not include such primary strengths as programming languages (several), data structures, operating systems, compilers, discrete structures, and formal languages, to name a few, then the program or department should probably be named otherwise. As early as 1963 the name Computer Science was predominant (6) for computer-related curricula. By 1979 (7,8) 58% of the 4-year programs, 62% of the graduate programs carried the Computer Science label. The next most popular program title was Data Processing at the 4-year level (8%), and a tie between Information Systems and Computer Science and Engineering at the graduate level (7%). For the next ten years the greatest growth is likely to be in the

information systems area, either in the business schools as stand-alone programs, or in cooperation with computer science departments.

Information Systems programs can be characterized as the study of information systems. An information system is defined (9) ". . . as a collection of people, procedures, and equipment designed, built, operated, and maintained to collect, record, process, store, retrieve and display information." Obviously, our concern here is for the cases where the computer is the central piece of "equipment." In (4) the ACM Committee on Computer Education for Management (now Committee on Curricula in Information Systems) states that "The knowledge and abilities necessary to work effectively in this field may be characterized as obtainable by integrating concepts relating to people, models and systems for the application of computer technology in the context of organization and society." In general, an information systems program must treat both the study of organizations and the study of computer systems. The extreme shortage of faculty in the latter area has prevented the needed development of programs in information systems. Even on campuses where both computer science programs and business schools exist, there has been little success in cooperation between the two areas to provide a joint program in information systems. The many pressures in academia (emphasis on research, publications, student credit hours as productivity measures, etc.) encourage provincialism and work against voluntary cooperation. Therefore we are dependent largely upon the business schools' bootstrapping their way into such programs and they have been very slow to do so.

Computer Engineering as a program name has come into being rather recently. One institution reported a so-named program in 1969, two by 1971 (10), six by 1973 (8, 1975), nine by 1976 (7) and eleven by 1978 (7).

Data Processing (DP) or Electronic Data Processing (EDP) or Automatic Data Processing (ADP) can be considered a subset of Information Systems. Usually such programs are job-oriented with particular attention to skills leading to jobs in and around the computer room of a business organization. In 1979 (8, 1979) 55% of the 2-year programs were called Data Processing while only 8% of the 4-year programs and 3 graduate programs carried this title. This kind of program will remain primarily in the 2-year institutions. Graduates of these programs are rather restricted in their employment opportunities (largely small computer installations or data preparation and operations divisions of large centers.) The administrators of such programs should rely more on preparing their students for the first two years of 4-year programs. This requires considerable effort on their part to maintain contact with the administration of 4-year programs in order that the students can make a smooth transition or transfer without loss of credits. Students suffer from poor articulation between upper and lower level programs. In particular, transfer from a community college to a senior level institution is extremely difficult when students have not completed required lower level courses; upper level institutions are not authorized to offer lower level courses.

Genesis of a Degree Program in the Computer Sciences

Most computer science degree programs (by 1979 there were an estimated 688 so named programs at all levels [8]) began with course offerings within mathematics departments. Growth was usually rapid in departments with an applied emphasis. As job opportunities increased for computer science majors, the departments created major status and eventually a new department was formed. By 1976 about 394 or 57% of all degree programs were located in departments named Computer Science. In only rare circumstances have computer science programs thrived in any department not carrying the name in the title. As a rule of thumb and depending upon the people involved, when the numbers of majors in one of the computer sciences exceeds the number of majors in the host department, then a separate department should be established, or at least, the name changed to identify the computer science program (e.g. Mathematics and Computer Science, not Mathematical Sciences; Accounting and Information Systems; Electrical and Computer Engineering; etc.) A separate identity for computer science is necessary to focus the appropriate recognition for the program's contributions. When a computer science track is placed within an older, more established department, promotion and tenure decisions are typically determined by those faculty enjoying the longest tenure, or the power structure of the department. Such faculty determinations characteristically lack the professional sensitivity and understanding of the scholarly contributions of their computer science colleagues which a true peer review can provide. Consequently, promotions are often denied to competent, young computer science faculty disproportionate to the quality of teaching, research and service provided the institution and the department.

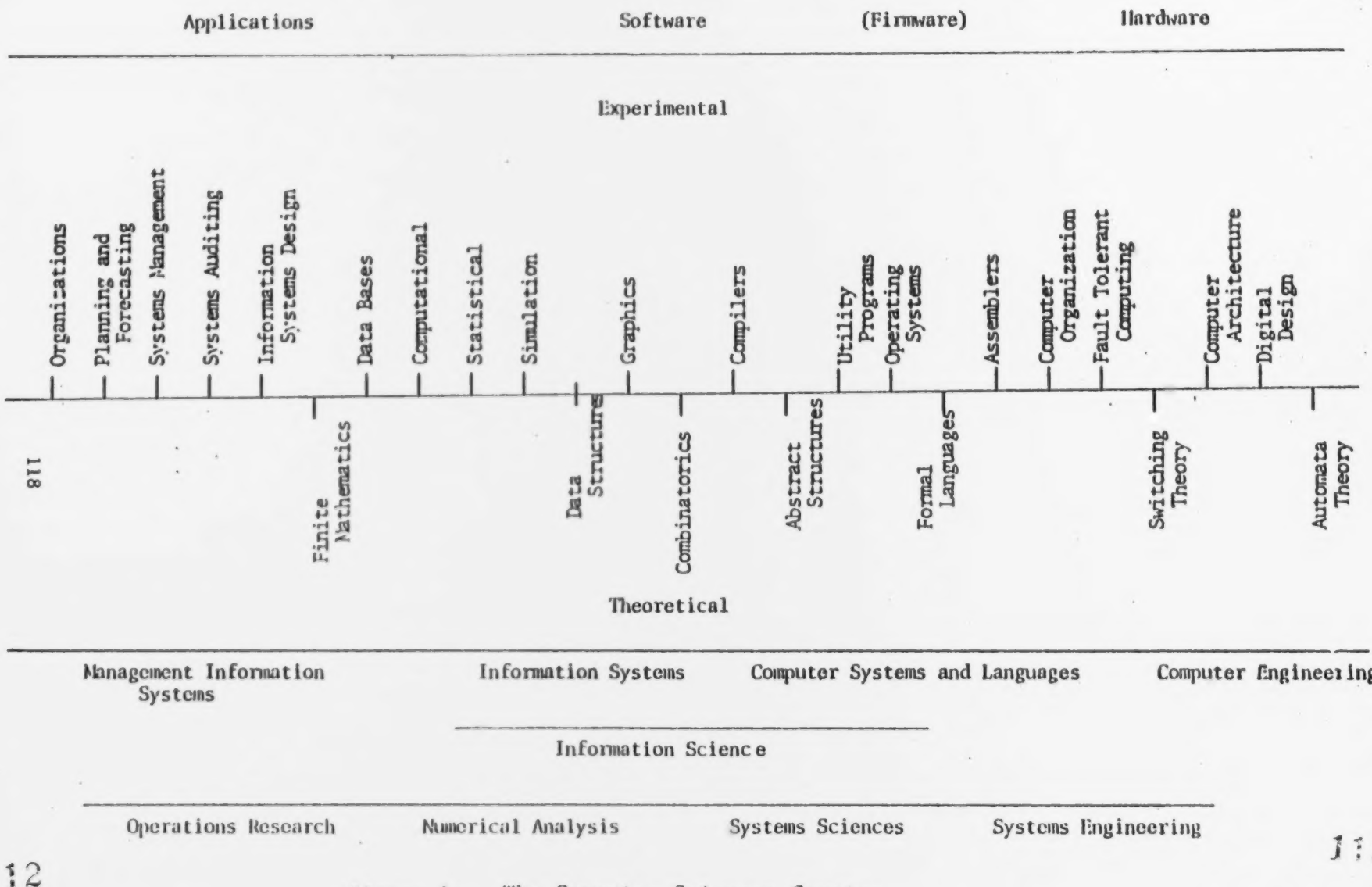

Figure 1: The Computer Sciences Spectra

VII. STAFF ANALYSIS AND RECOMMENDED ACTIONS

Approved by Board of Regents May 15, 1987

REVIEW OF COMPUTER DEGREE PROGRAMS IN THE SUS

EXECUTIVE SUMMARY,

STAFF ANALYSIS AND RECOMMENDATIONS

The Review Team

The review consultant team of Dr. C. V. Ramamoorthy and Dr. Roland Spaniol visited the nine SUS universities in the Fall of 1986. They were joined at the University of Central Florida, the University of North Florida, and the University of West Florida by a consultant or consultants engaged by those campuses to assist in the review. All consultants had been advised of the twelve statewide issues to be examined; individual institutional concerns also were related to the team while they were on campus.

Degree Identity

Our nine universities provide computer degree programs in a variety of curricula and within vastly differing administrative structures. For example, computer science programs are found in Colleges of Arts and Sciences (as stand-alone departments or as part of mathematical sciences departments), in a separate Division of Computer Sciences, and in a Department of Computer Sciences and Engineering (in a College of Engineering). Computer engineering programs are all in Colleges of Engineering; however, information systems programs are found in several different kinds of units. The titles used to designate the degrees being offered reflect these organizational structures, and sometimes obscure the true nature of the program the student has completed. This was not among the twelve Systemwide

issues; however, the consultants felt that it warranted attention. This led to the recommendation that the SUS use three generic degree forms (computer science, computer engineering, and computer information systems), and title each of our degrees to be recognizable as one of these. The consultants also recommended that some of our administrative structures or locations should be changed, to help with the degree identification problem as well as to foster appropriate interactions among faculty in related disciplines (e.g., computer science with computer engineering, computer information systems with management information systems). Table I presents the authorized computer degree programs in the SUS, categorized in the generic types.

Approved by Board of Regents May 15, 1987

AUTHORIZED COMPUTER DEGREE PROGRAMS IN THE STATE UNIVERSITY SYSTEM 1986

	Computer Science	Computer Engineering	Information Systems	Computer Technology	Department Location
UF	B M	B M D	B M		Arts & Sci Engineering Business
FSU	B M D				Arts & Sci
FAMU				B	Engineering, Agriculture, & Technologies
USF	B* M* D*	B M D		B	Engineering
FAU	B* M*	M D	B M		(Moving to Consolidate)
UWF	B* M*		B* M*		Business
UCF	B M D	B M D		B	Arts & Sciences, Engineering
FIU	B* M* D*				Mathematical Sciences
UNF	B* M*		B* M*	B**	Separate Division

LEGEND B = Bachelor's
M = Master's
D = Doctorate
* = Track in Differently-Named Program
** = UNF No Longer Offers This Degree

TABLE I

Computer Technology Programs

The consultants found that three of our institutions were offering computer technology degree programs. One of these (FAMU) offers that as its only computing degree; the other two (UCF/USF) offer the program under the auspices of their engineering colleges. These latter two universities' programs were not given coverage in the computer science/ computer engineering self-studies prepared by their institutions; hence, they did not receive an in-depth programmatic and resource evaluation in this review. Nevertheless, the consultants had the same concerns about those programs as was expressed in the 1978/79 computer science program review--such degree programs often lack the breadth and depth found in the traditional computer science, engineering, or information systems programs, and thereby may not provide sufficient tools for the recipient to adjust rapidly to the ever-changing computing career demands once they have entered the profession. At a time when all institutions must examine carefully their investments in programs, efforts should be made to direct resources to programs which provide the strongest integration of quality, satisfaction of regional needs, and suitability to the university's mission. In the long term, the students and the universities will be served better through directing resources to computer engineering or computer science hardware programs as opposed to the hardware component of computer technology, and toward computer information systems as opposed to the data processing component of the technology degree. Thus, the consultants have recommended that the SUS phase out its computer technology programs gradually, and redirect those resources appropriately.

Systemwide Issues

1. The 1978/79 Review

That previous review proposed a plan for offering computing degree programs throughout the SUS. The present consultants looked at what had been done, Systemwide, and concluded that the general response and development over the past eight years has been good. They were concerned about the continued offering of computer technology programs, as mentioned above, but felt that the overall offerings that had developed in computer science and computer engineering were quite satisfactory. Information systems program needs have not been addressed as comprehensively, and require further attention by the universities in general.

Masters level programs have been established at eight institutions, doctoral programs in computer science at three and in computer engineering at four. The Ph.D. programs are young, and are just beginning to produce graduates; the masters programs collectively are moderately productive. Graduate program development has been basically consistent with the 1978/79 recommendations. Those earlier consultants felt that the State could support multiple Masters programs and some additional Ph.D. programs.

2. New Programs/Program Accreditation

The only new baccalaureate program suggested by the present consultants was in Computer Engineering at FAU, although they also recommended that FAMU revise its curriculum and seek to replace their computer technology program with a B.S. in Computer Information Systems.

At the Masters level, the consultants endorsed the concept of the UNF Masters proposal, and suggested some minor modifications and program delivery suggestions that should be taken into consideration prior to implementation. No other new Masters degrees should be anticipated before the next review of this discipline.

Ph.D. programs are expensive, and should not be initiated before the faculty and resources are on hand to make them successful and of high quality. Some of our non-Ph.D. universities are contemplating proposing Ph.D. programs in the future, however are not now in a position to deliver them. Of the institutions now offering Ph.D. degrees, there may be some new program proposal activity over the next few years, e.g., adding computer science at UF and USF. The one need which is not being addressed adequately at present is for the Ph.D. in Computer Information Systems.

Undergraduate programs in computer science and computer engineering have accrediting agencies, the Accreditation Board for Engineering and Technology (ABET) and the Computing Sciences Accreditation Board (CSAB), respectively. The consultants feel that accreditation is a means of maintaining currentness and quality in program, and recommend that all SUS programs pursue accreditation. The three Computer Engineering programs are ABET accredited, and two of our universities are seeking CSAB accreditation (several more expect to do so, also).

3. Supply and Demand: Students

Undergraduate student enrollment in the SUS computer programs is relatively stable, whereas, nationwide, such programs are experiencing a declining enrollment. Enrollment levels are still such that computer program faculty experience large classes and teaching loads; and the requisite instructional equipment stretches budgets. The consultants suggested the idea of restricting access further than the present limited access standards have achieved, and of surveying outstanding universities nationwide to obtain a benchmark average class size, teaching load, and program size.

Minority student recruitment and retention efforts were considered insufficient to attract students in the quantities the consultants felt should be accomplished. Additional emphasis on this and on graduate recruitment of all kinds of students should be given throughout the System.

Employment opportunities remain high for program graduates. Nevertheless, all curricula should be examined to assure that they contain the proper blend of education and training in the discipline, so that students will be prepared for professional opportunities (both entry-level and for continuing advancement), and for further study if they wish. Institutions should look carefully to see that they are fulfilling their region's needs in computing in so far as is possible.

4. Supply and Demand: Faculty

Demand for computer program faculty is still in excess of supply; however, the situation is improving. SUS institutions have had better success in attracting faculty in the past few years, and that trend should continue. Area of specialization should be a criterion in obtaining new faculty--each SUS department should determine a (broad) focus for its research emphasis and recruit faculty in support of that. Obtaining quality faculty will require competitive salaries, teaching loads, and seed-grant opportunities.

It was noted that several SUS universities are making very good progress toward upper-quartile status--excellent faculty is a necessary component of that sort of rating.

5. Equipment

Equipment for undergraduate instruction is very good throughout the System. There are a few courses (e.g., Computer Hardware) for which some universities might provide greater laboratory and equipment resources, and space problems prevent placing equipment in suitable proximity to program delivery areas at some schools.

Graduate equipment should be tailored to the universities' research focus; and universities should be cognizant of maintenance costs when accepting donated equipment. Seed money for equipment for junior faculty is an important component of developing a research program. The life cycle of equipment, particularly for research, is 3-5 years.

6. Professional Activity and Currentness of Curricula

The consultants found that a greater emphasis on faculty development was needed at most SUS universities. This was reflected in money allocated for travel, colloquia, etc., and the amount of seminar activity the consultants observed. Individual study associated with course development and preparation is a form of professional development observed at all SUS schools.

The curricula at most SUS universities have very strong aspects; however, many lack a good balance between theoretical and applications-oriented courses. It is suggested that at least a quarter of the offerings beyond the basic and core requirements be applications-oriented, and at least a quarter be more theoretical or technical in nature. A careful examination of requirements and offerings with that balance in mind is recommended. The consultants also recommended the forming of joint student/faculty/industry advisory groups to help keep the curriculum current and responsive. Periodic meetings of program directors or chairmen from computer units statewide could provide a forum for exchanging curriculum ideas, as well.

7. Relationships with Industry

University/industry relations are good throughout the SUS computer programs. This is manifested by equipment donations, industrial personnel serving as SUS adjuncts, contracts for university studies, and hiring of SUS program graduates. The partnership might be strengthened through development of joint research conferences and symposia.

8. Teacher and Continuing Education

SUS institutions have not done enough to provide continuing education possibilities for nearby computer professionals. The consultants recommend that each university develop mechanisms to monitor and devise responses to the professional education needs of computer experts in their region. The joint advisory committee of issue #6 could be helpful in this.

Teacher certification in computer science was not being addressed by any of the departments visited. The imminence of this certification suggests that our institutions now should be developing and determining offerings that can be used for in-service certification.

9. Computing across the Curriculum

This did not seem to be an issue at any university.

10. Articulation/Program Direction

Articulation efforts with nearby community colleges ranged from excellent to virtually nonexistent. There is a general reluctance for universities to accept a community college's teaching a fundamental computer course which will become a part of the student's university curriculum. This is a mistake on the part of our universities, since those introductory courses are filtering toward high schools nationwide, and the development of the discipline provides more material to be offered at the upper level. Universities should establish agreements whereby nearby community colleges are encouraged to teach those elementary courses and to allow their students to flow naturally into the university major, taking advantage of the Statewide Course Numbering System.

11. Branch Campuses

A branch campus becomes an issue when individuals from the main campus are part-time purveyors of course work at remote sites, and the site is attempting to offer a complete program in that manner. Complete programs should be offered only when a core of resident faculty can be recruited to provide the preponderance of the courses.

12. Funding for Computer Access

It is recommended that, on a trial basis, each university fund instructional computing "off the top," and not use a charge-back algorithm. This may foster more complete use of the facility, and will prevent students from encountering $0 balances when no one is available to refund their accounts.

Institutional Reports

Brief reports were prepared for each of the nine institutions, citing strengths, opportunities for improvement, and giving specific recommendations for institutional considerations. A brief synopsis of these reports is given below, by institution. Generally, the consultants found the SUS programs to have good curricula, average to good faculty and students, and strong institutional support. The programs at UCF, UF, FSU, and USF were cited as the strongest overall.

University of Florida

The consultants were impressed with the UF program, particularly the computer-engineering component. The administrative organization of the programs was considered to represent an impediment to program development, and the College of Engineering location not appropriate for computer information systems. Nevertheless, the programs have developed nicely since the 1978-79 reviews (at both graduate and undergraduate levels), and all components are viewed as being very strong. Computer access for students is especially good at UF because of the recently-completed engineering building.

Consultants Recommendations:

1. Separate the Computer Information Science Department into two distinct components; one component to provide computer engineering and computer science offerings, and the other to provide the computer information systems curriculum. This will provide better degree identification and will help to strengthen the curricula of all three colleges' computer degree programs.
2. Once these departmental components have stabilized, take steps to establish a School of Computer Science and Computer Engineering within the next five years. This should be not only a strong teaching entity, but also an outstanding research component for the University.
3. Develop plans to offer the authorized Ph.D. in the area of computer science through the College of Arts and Sciences. This is preferred to offering a Ph.D. degree through an engineering college to a non-engineering undergraduate major.

4. The computer engineering undergraduate component has been accredited. The other CIS components should seek accreditation as they can be made ready.
5. All the undergraduate core courses should be taught by regular, tenure-track faculty, and not by teaching assistants and adjuncts.
6. The review team was impressed by the eagerness of Florida industries to help the University with research support, fellowships, etc. The Department should capitalize on this relationship by encouraging support for colloquia and faculty travel.
7. Improve minority and disadvantaged student recruitment efforts, particularly in the computer programs leading to degrees in Arts & Sciences and Business.
8. Hire a strong, research-oriented Department Chairman and recruit research leaders to provide additional advice on the structure and development of the graduate and undergraduate programs.
9. Keep striving to improve the access to the mainframe computing facility and establish more workstations for students and faculty. Remote access, local area networks, software and hardware sharing all must be made available and maintained at state-of-the-art levels.

Florida State University

The FSU computer science program has grown in size and quality since its separation from the mathematics department. The program is quite strong, particularly in its theoretical components. Research activity and the department's interactions with other strong FSU departments are both very good. The FSU program articulates well with nearby community college computer programs.

Consultants Recommendations:

1. It is recommended that immediate and urgent attention be focused on alleviating the space problems.
2. The computing resources all should be located in close proximity to one another for the convenience of the students. The hardware lab for the undergraduate logic design courses should be supplied with state-of-the-art instructional devices. Computer labs should be open for longer hours for student accessibility, and remote dial-up facilities should be expanded.
3. The Department and the College should increase their investment and undertake new initiatives to expand minority and women enrollment.
4. It is strongly recommended that more balance be established in the curriculum by adding additional courses and laboratories that emphasize practice.
5. The graduate degree program being proposed by the Super-Computer Research Institute has potential for having adverse impact on the Computer Science degree programs--through

redirecting faculty, resources, and products away from existing programs. A comprehensive study of the program should be undertaken, with the participation of the Computer Science Faculty, before any further commitment be made.

Florida A&M University

FAMU's computer technology program has been supplying the preponderance of the SUS minority graduates from computer programs, and those graduates are reported to be doing quite well entering the profession. The 1978-79 recommendation that a computer information systems program be developed to replace the technologies degree has not yet been accomplished, although some curriculum strengthening has occured and additional faculty obtained.

Consultants Recommendations:

1. Develop an Information Systems curriculum along the lines of the DPMA model curriculum, and replace the Technologies degree with a B.S. in Computer Information Systems.
2. Move the computer degree program out of its present college into the School of Business, or make it a stand-alone unit.
3. Initiate an annual survey of program graduates, beginning with the 1986 graduates, to determine their level of satisfaction with their degree programs and the opportunities those programs have provided, both in industry and in further education.
4. Reduce teaching loads by consideration of reallocating faculty positions to where the enrollment is; and increase

support for advisement to further lighten the burden on faculty.

5. Increase support for faculty development, and for faculty to engage in research and travel to professional conferences and meetings.
6. Do not consider developing a graduate program until improvements in the undergraduate curriculum have been implemented and have had time to stabilize.

University of South Florida

USF's program has been strenghened significantly in the past five years, and it is now one of the upper-echelon programs in the state. The opening of the new engineering building will provide an excellent facility in which the development can continue. The USF programs' relationships with local industry are excellent.

Consultants Recommendations:

1. The colleges' first priority should be to find a strong research leader and permanent chairman for the Department.
2. Since the Department is awarding Ph.D. degrees, it must establish strong research focus, and recruit a critical mass of faculty to support that focus.
3. The Department should continue to seek CSAB accreditation.
4. Additional theoretical coursework should be incorporated into the computer science and computer engineering curricula. The Information Systems curriculum is far too scientifically oriented. If it is to be continued (see the following

recommendation), it should incorporate more substantial business-oriented coursework.

5. The computer technology program should be phased out gradually and be supplanted by a Computer Information Systems program, developed in connection with, and perhaps situated in, the College of Business. Several model curricula have been developed for such a program.

Florida Atlantic University

FAU is reorganizing its programs in computer science and computer engineering into a separate unit; they will begin staffing and curriculum revisions as the reorganization is implemented. This will give them them opportunity to draw from the strengths of the programs involved, eliminate duplication, and improve even further their very good relationships with the nearby industrial community.

Consultants Recommendations:

1. Designate the initial staffing of the new unit quickly, drawing suitable faculty from the existing three departments.
2. Give the new unit responsibility for developing undergraduate and masters degree curriculum options in computer science which are compatible with existing options, and eliminate the computer science programs from CIS and Mathematics.
3. Move the computer engineering masters program to the new unit, and have the new unit develop a proposal for a bachelors program in that discipline.

4. Eliminate unusual degree titles, e.g., Master of Applied Science, in favor of the more traditional ones, and use the names "Computer Science", "Computer Engineering", and "Computer Information Systems" to identify the programs.
5. Move to strengthen the Computer Information Systems programs by increasing the mathematical requisites and the coursework in areas such as database, networks, etc.
6. Make a concentrated effort to articulate the new unit's programs very closely with the nearby community colleges.
7. Do not move toward providing full program offerings at branch campus locations until resources are adequate that such a move will not jeopardize main campus delivery.
8. The Information Systems Program is a most important undergraduate program for the region. Its quality should be improved by requiring a stronger mathematics base. The graduate program in the current CIS department should be strengthened at the same time that the new unit is building its programs.

University of West Florida

UWF has a unique program, with distinct components designed to respond to needs of the nearby military bases and to local business and industry. The computer facilities are excellent, and UWF has very good articulation arrangements with the nearby community college.

Consultants Recommendations:

1. Seek an outstanding Computer Information Systems expert to fill the new Eminent Scholar position. The 85 percent

business-option/15 percent science-option distribution of majors in the program suggests that a business oriented person should be hired for this position.

2. Additional hiring at the lower academic ranks should follow the general guidelines given in the Systemwide sector of this report.
3. In the next five years, it is unlikely that the masters programs will grow significantly; therefore, the faculty should target improvement in quality as the major thrust. Actions that will tend to improve the quality include reduction of class sizes and teaching loads, and increasing faculty resources for research and professional development.
4. For both the Bachelors and Masters, develop the two curricular tracks and institute program names of Computer Science for the process control track and Computer Information Systems for the other track.
5. Continue to pursue the affiliation with the Carnegie-Mellon Software Engineering Institute (SEI); however, do not commit scarce university faculty resources to significant development or incorporation into the UWF curriculum of SEI curriculum modules.

University of Central Florida

UCF has separate departments for computer engineering and computer science. The computer science program was one of the original SUS Programs of Excellence, and has done a good job in developing a very

strong program with high quality faculty and good curriculum. The computer engineering program also has a good curriculum and active, dedicated faculty. Student quality in the undergraduate programs appears good to excellent.

Consultants Recommendations:

1. Develop a plan to analyze the feasibility of and alternatives to joining the Computer Science and Computer Engineering programs in a separate academic unit. A closer relationship will enhance the interaction among the two faculties and will help control the duplication and rivalry that presently exists. Alternatives should include joint appointments, joint course listings, and a committee to investigate course content duplication.
2. The Computer Science and Computer Engineering departments need more faculty members in specific, targeted research areas. A critical mass of faculty is required for truly effective research in an area of departmental focus. Each department should develop a focus and concentrate on strengthening a few areas of directed research that will result in collaboration with industry as well as with other departments.
3. The University should embark upon an extensive public information effort to describe the potential and promise of the programs for students and industry.
4. The theory component of the Computer Science program was materially enhanced with the appointment of the distinguished

chairman. This should be further enhanced with the addition of young new faculty to teach the core theory courses.

5. The Computer Technology program should be phased out gradually, and be replaced with a Computer Information Systems program, developed in conjunction with, and perhaps located in, the College of Business.

Florida International University

The FIU computer science program is housed in the Mathematical Sciences Department. The program has very capable faculty; and FIU is recruiting additional dissertation-directing faculty to support the recently initiated Ph.D. program. Computer Sciences is a high priority discipline at FIU.

Consultants Recommendations:

1. Establish a Department of Computer Science, and move the computer programs out of the Mathematical Sciences Department.
2. Be selective in the recruitment of new faculty to ensure that their research and teaching interests relate to the software needs of the region. In the recruitment process, advertise the selected Ph.D. research focus of the department, and advertise for teams of applicants.
3. Work with the University of Miami to enhance the computer engineering, hardware, and architecture content of the curriculum.

4. Increase the number and dollar amount of assistantships, fellowships and scholarships to entice more full-time M.S. and Ph.D. students.
5. Increase the motivation for the tenured faculty to become active in research appropriate to the needs of the new department.

University of North Florida

The computer degree programs at UNF are situated in a stand-alone Division. This permits them to have excellent coordination of offerings and to utilize their resources well. This has contributed to their being able to acquire several very talented new faculty, and to articulating their programs well with the community college. The Division has good relationships with local business and industry, and has the strong support of the UNF administration.

Consultants Recommendations:

1. The proposed M.S. in Computer and Information Sciences is a good program, and is much needed in the Jacksonville area. However, the program as proposed is too ambitious for the Division to implement successfully. A detailed plan for restricting the offerings and for phasing in the program slowly should be developed prior to seeking implementation approval.
2. The Division requires additional faculty to maintain their undergraduate offerings--the existence of a new master's program will exacerbate the teaching load situation.

Enrollment restrictions and a cutback in course offerings should be considered if additional faculty cannot be obtained.

3. Additional software for the mainframe should be obtained in support of the Division's programs. Large scale database software and fourth-generation languages are examples of some needs.

4. Strengthen the curriculum of the Information Systems track in the direction of the current Information Sciences track, and phase out the latter one. This will allow for better scheduling, fewer course offerings, and better use of faculty. It also will bring the program names into ones with greater name-recognition.

5. Enhance the advanced computer science coursework by adding hardware support for Algorithm Theory and Computer Architecture courses. Make artificial intelligence and expert systems courses available to the Information Systems track majors.

Summary of Systemwide Recommendations

The following summarizes the consultants' recommendations for Systemwide consideration. Page numbers refer to pages in the report itself.

1. Each institution should consider a planned reorganization which will result in the designation of recognized degree structures at all levels, and suitable administrative location for their effective delivery. (Page 5)

2. The State University System should consider phasing out computer technology programs and redirecting those resources to the remaining three types of computer degree programs. The universities should report to the Regents by January 1988 their plans to phase out or continue computer technology programs. (Page 7)
3. Institutions should monitor the needs of their constituencies to see that the Information Systems curricula being provided are suitable to and adequate for the need. (Page 9)
4. SUS computer science programs should be administratively situated in locations which foster continued quality and also the professional development of the program faculty and of faculty in related disciplines. (Page 10)
5. All SUS institutions should be sensitive to the natural symbioses among computer science, computer engineering, and electrical engineering. They should design the administration of such programs to foster the interaction of these faculties, facilities, and curricula. (Page 11)
6. Each university should examine its master's curriculum to see that offerings allow all students to select both theory and applications which are appropriate to their particular degree objectives. Planning for master's programs beyond those currently proposed should not be on the horizon prior to the next review. (Page 12)
7. The SUS should concentrate on the development and strengthening of existing Ph.D. programs, and should consider initiating new programs only when in a position to see that those can be started

with sufficient faculty, student and equipment resources to be of high quality from the outset. The primary Ph.D. need, statewide, presently is for Computer Information Systems. (Pages 13 & 15)

8. The Board of Regents should encourage the accreditation of computer degree programs in the SUS. (Page 17)
9. Each SUS institution should reaffirm its commitment to recruit and retain highly qualified minority students. Graduate student recruitment efforts in general also need to be increased. (Page 21)
10. Florida should survey selected high quality institutions nationwide to determine the computer program teaching loads there--both number of courses and student enrollments. This data should be used to determine a suggested load for SUS computer program units. (Page 21)
11. Each SUS university should establish a research focus, and recruit faculty with expertise supportive of that focus. Each university should strive to acquire one or two established leaders in its program's area of focus, and use those to attract outstanding younger faculty. (Page 25)
12. At many SUS institutions, laboratory equipment associated with computer hardware courses is inadequate. Steps must be taken to provide proper support for this essential curriculum component. (Page 27)
13. Each institution should develop an internal catalog of sharable hardware and software; these catalogs should be available internally through Local Area Networks and throughout the SUS through the Florida Information Resources Network. (Page 28)

14. A joint student/faculty/industry advisory group should be formed by each institution to help guide curricular and programmatic development. (Page 29)
15. Established relationships with industry should be expanded to include cooperative efforts such as statewide conferences and symposia. (Page 31)
16. Each SUS university should develop and provide comprehensive continuing education opportunities for local computer professionals. (Page 32)
17. Each university computer program unit should work with local school districts and the College or School of Education to develop special training programs leading to certification for in-service public school teachers of computer science. (Page 33)
18. Each SUS university computer program unit should establish agreements whereby its primary feeder community colleges would be encouraged to offer introductory major coursework in computer science which would then transfer into the university's program. (Page 34)
19. A full degree program should be offered at a branch campus only when the university has a core of full-time faculty in the discipline located permanently at the branch, and provides adequate equipment support to assure that the branch offering maintains the quality achieved by the main campus operation. (Page 36)
20. A computer access method provided should encourage the full use of the computer facility; each institution should consider implementing the "library" funding model, in which the computer

services are funded off the top, and access fees are not charged to students and faculty. (Page 37)

Staff Recommendations

Based upon the analysis of the consultants' review report, the following recommendations are proposed for Board of Regents action:

The Universities are commended for the manner in which they have responded to the need to develop comprehensive computer programs in the face of tight resources, scarce faculty, and burgeoning technology. Goals for the next five years should focus on the continued development of existing programs and on strengthening of quality. Only a modest amount of new program development and program growth is anticipated.

The following actions are intended to support the universities' efforts toward achieving excellence in their programs.

1. All SUS institutions shall examine the designations of the computing degrees they offer and seek to name them with the appropriate generic computing degree titles (Computer Science, Computer Engineering, and Computer Information Systems); the administrative locations of the programs should be examined at the same time, for appropriateness.
2. FAMU shall develop and propose its plan by October 1987 for phasing out the computer technology program and replacing it with a bachelors degree program in computer information systems. UCF and USF shall determine the feasibility of offering or phasing out their computer technology programs and replacing them with appropriate components within computer sciences, computer engineering, and

computer information systems. The results of the USF and UCF investigations, along with those universities' plans for their computer technology programs, shall be presented for Board of Regents review in January 1988.

3. All institutions are encouraged to consider seriously the consultants' recommendations with regard to masters degree programs, graduate student and minority student recruitment, establishing a research focus, balance in curriculum, and university/industry interactions.
4. All SUS institutions shall establish agreements whereby primary feeder community colleges offer introductory major course work in computing. Such course work will be designed by the university and the community college working together; it will satisfy the corresponding requirement in the appropriate university computer degree program and will use appropriate common course numbering.
5. Each SUS Institution shall examine its offerings in computer information systems to see if regional and state needs are being satisfied. The Board would be willing to consider feasibility requests for a Ph.D. in Computer Information Systems.
6. SUS Institutions are encouraged to work with local school districts to develop plans for addressing the in-service certification needs of public school teachers of computer coursework.
7. All SUS universities are encouraged to review the consultants' Systemwide and institutional reports carefully, and use the recommendations therein to devise a plan for the development of their computer degree programs and the enhancement of program quality over the next five years.